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केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान कोचिन, भारत
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INDIAN COUNCIL OF AGRICULTURAL RESEARCH

समुद्री मात्स्यिकी सूचना सेवा : समुद्री मात्स्यिकी पर आधारित अनुसंधान परिणामों को आयोजकों, मत्स्य उद्योगों और मत्स्य पालकों के बीच प्रसार करना और तकनोलजी का प्रयोगशाला से श्रमशाला तक हस्तांतरित करना इस तकनीकी और विस्तार अंकावली का लक्ष्य है ।

THE MARINE FISHERIES INFORMATION SERVICE : Technical and Extension Series envisages dissemination of information on marine fishery resources based on research results to the planners, industry and fish farmers and transfer of technology from laboratory to field.

Abbreviation - *Mar. Fish. Infor. Serv., T & E* Ser., No. 157 : October, November 1998

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Front cover photo : Ventral view of the giant octopus *(Octopus doflein)* caught from Gulf of Mannar off Rameswaram (Ref. Article No. 878)

मुखावरण चित्र : रामेश्वरम में मान्नर खाडी से पकडा गया भीमाकार ऑक्टोपस (अष्टभुज) *(ऑक्टोपस डोफ्लीनी)* का अधर भाग

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FOOD TECHNOLOGICAL RESEARCH INSTITUTE REGIONAL CENTRE MANGALORE 28/6/2000

Introduction

Marine macroalge which are popularly termed as **Seaweeds** belong to the primitive group of nonflowering plants known as Thallophyta. They are autotrophic plants and grow in the intertidal and subtidal regions of the sea. They grow abundantly wherever rocky or coral substratum is available for their attachment with the help of rhizoids or holdfast. For centuries, seaweeds of various kinds have been put into use in the south and southeast Asian countries. Seaweeds are the only source for the manufacture of colloids like agar, algin and carrageenan which are used in food, chemical and pharmaceutical industries. Seaweeds are rich in protein, vitamins, minerals and trace elements. They are also used as food, fodder, fertilizer and recently as a source of drugs and therapeutically importar substances. In India about 720 species seaweeds are available, of which 60 are commer ally important. They occur abundantly along the coasts of Tamil Nadu, Gujarat, Lakshadweep and Andaman-Nicobar Islands.

Developing countries produce nearly 40 % of the world's seaweed supplies for the manufacture of phyco-colloids. Fifty per cent of seaweeds are utilised for agar production, 32 % for carrageenan and 18 % for alginate production. Although, the major share of seaweeds is produced by developing nations, the phycocolloid manufacturing industries remain concentrated in a few developed nations viz., Denmark, France, Japan, Norway, Spain, UK and USA the main reason being the secracy maintained by the industries in the extraction and purification technologies.

In India there exist more than 60 seaweed industries and are involved in the production of agar alginates. Many more such industries are also coming up. There is a growing awareness and enthusiasm among the private sector to develop seaweed industry in our country, although it is centered at present in the production of agar and algin only. The utilization of edible seaweeds is practically nil. Seaweeds like *Gracilaria edulis, G. crassa, G. foliifera* and *Gelidiella acerosa* are widely exploited for agar manufacture and species of *Sargassum* and *Turbinaria* for algin extraction from the east coast of India. However, the edible and other seaweeds consisting about 70 % of the standing crop of seaweeds are under-exploited for want of awareness. This article is prepared with the object of evincing awareness of the manifold utilitarian aspects of seaweeds.

I. Seaweeds as phycocolloids

1. Agar

Agar is the major constituent of the cell-wall of certain red algae (Rhodophyceae), especially the members of families Gelidiaceae, Gelidiellaceae and Gracilariaceae. Agar-agar is the Malay word for a gelling substance extracted from *Eucheuma*, but now known to be carrageenan. The term agar is now generally applied to those algal galactans, which have agarose, the disachharide agarobiose as their repeating unit. Agar (Fig. 1) consists of a chain of 9-β galactopyranose units linked in 1, 4 bonds with a sulphated L. galactose.

Fig. 1. Dry agar strips.

Visit Marine Aquarium at CMFRI Research Centre, Vizhinjam in Trivandrum, Kerala
Enjoy the Spectacular Underwater Wonders

Sources: Raw materials for the production of agar are red algae such as *Gelidiella acerosa* (Fig. 2), *Gracilaria edulis*, *G. verrucosa* and species *Gelidium*, *Pterocladia*, and *Ahenfeltia*.

Fig. 2. *Gelidiella acerosa*, highly priced seaweed extensively exploited by the industries for producing agar.

Method of extraction: The dried raw materials are purified from debris, sand and shells and other attached weeds. Then they are soaked in freshwater and dried in sun. The soaking and drying are repeated till the seaweeds are bleached. Boil the seaweed for 3 to 4 hours with occasional stiring. The boiled slurry is filtered by means of filter press. The filtrate becomes gel at room temperature. Repeated freezing and thawing of the flocculated gel purify the gel further. This gel is air dried or sun dried to get agar strips (Fig. 3). Agar strips can be powdered and marketed. To increase the yield and gel strength of agar, it is preferable to apply an alkaline treatment with sodium hydroxide for nearly one hour at the rate of 2 to 3 % alkali solution of 20,000 l/tonne at 90°C. This pretreatment before boiling eliminates sulphuric esters and converts a-L-galactopyranose units into 3, 6-anhydro-a-L-galactopyranose thereby increasing the gel strength.

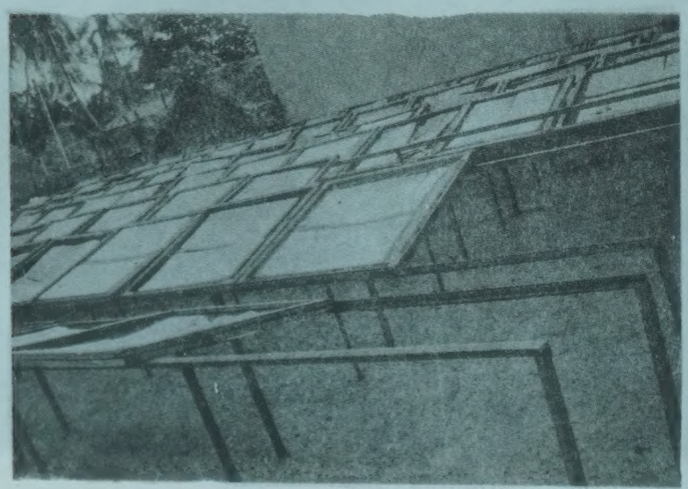

Fig. 3. Freez-thawed agar gel kept for drying.

Uses: In food technology agar is used for gelling and thickening in the confectionary and bakery industries, as stabilizer for the preparation of cheese and for salad dressings. In fish and meat processing industry, agar is applied for canned products, as a protective coating against the effect of metal containers and against shaking during transport of these products.

Agar is also used as a clarifying agent for wines, beers and liquors. In pharmaceutical industry, agar is used as a laxative for chronic constipation, as drug vehicle and as a substratum for bacterial and fungal cultures. Agar is an ion exchanger and is used in the manufacture of ion exchange resins. In cosmetic industry agar serves as a constituent of skin creams and ointments. Agar is also employed in paper and textile industries as finishing and sizing agents.

2. Alginic acid

Algin or alginic acid is a membrane mucilage and a major constituent of all alginates (Fig. 4).

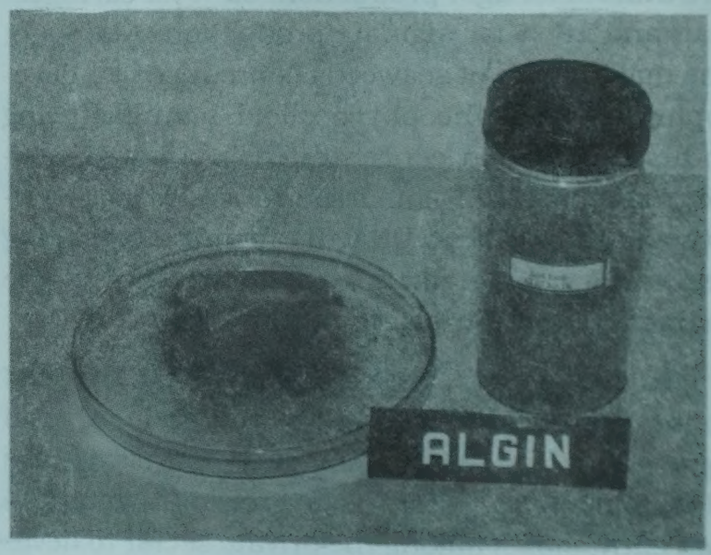

Fig. 4. Sodium alginate powder.

The various salts of alginic acid are termed 'alginates' (for example sodium alginate, calcium alginate etc). The term algin is used as a collective name for alginic acid and alginates but also as a trade name for sodium alginate. Alginic acid and its salts with divalent and trivalent metal ions are generally insoluble in water, while alkalimetal salts are water soluble.

Sources: Alginic acid is obtained from brown seaweed species such *as Ecklonia, Macrocystis, Undaria, Laminaria* and *Durvillea* from temperate areas and *Turbinaria, Sargassum* (Fig. 5), *Cystoseira* and Harmophysa from the tropical areas.

Fig. 5. *Sargassum wightil,* an algin yielding brown seaweed.

Extraction: The alginate or sodium alginate can be isolated from the brown seaweed materials by extraction with dilute sodium carbonate solution which converts the alginate into the soluble sodium from. The polysaccharide is then recovered by precipitation with acid.

In the laboratory, 10 g dry seaweed cut into small pieces are dipped in warm distilled water (60°C, 300 ml). After 2 hours the seaweed is removed from hot water by decanting. After homogenizing the seaweed, 200 ml of sodium carbonate solution (1.5 % w/v) is added and the mixture is heated under stirring for one two hours. 500 ml of water is added and mixed thoroughly. The hot solution is separated from the solid matter by filtration through a layer of celite-545 and then acidified with 10 % HC1 (at pH 1.0) to give a gelatinous precipitate. To the gel is added, 200 ml of 50% methanol and the mixture is exactly neutralised with 10 % NaOH solution under sterring. After standing overnight the mixture is filtered through a layer of cotton cloth to separate the neutral gel. This gel is washed successively with 60 % and then 95 % alcohol or acetone and is dried at 40°C for 12 hours. Carbonate salts of calcium or sodium are added at the desired level as to get desired pH of Calcium alginate or sodium alginate.

In industries, to one part of kelp (fresh or dried materials) three parts of 0.8-1% $CaCl_2$ solution is added either hot or cold, to remove laminaran, mannitol and other salts, washed with soft water. To remove residual alkaline earth salts, 5 % HCl is also added and then washed with excess soft water and is then digested with 4 % sodium carbonate solution in the proportion of two volumes of solution to one volume of kelp. Lixiviation is continued for about 3 hr at 40 - 50 C and the kelp is macerated at the same time until it is reduced to a paste.

The resulting paste is diluted with water in the ratio 3:7 and after being beaten into a homogenous suspension it is vigourously aerated. The liquid is then passed continuously at high speed through a centrifuge, where it is charged with air bubbles and then led to a clarifying tank. After 6-10 hr in this tank, the cellulose particles agglomerate to form a floating cake and the liquor is drained. The coloured liquor is decolourised by the addition of an adsorbant jelly made of hydrated alumina, gelatinous silica and aluminium alginate at a proportion of 20-25 parts of jelly to 100 parts of alginous material. The jelly is removed by centrifugation. The alginate is now precipitated by running the clear liquor into a mixing baffle where the liquor meets a strong stream of HCL arranged in such a way that the precipitate passes into another tank. The pH of the solution is maintained at 1.5-2.0 throughout. The precipitated alginic acid is placed in baskets and drained (Fig. 6) after which it is purified by alcohol and dried.

Uses: In pharmaceutical industry alginic acid is used as emulsifiers in watery emulsions with fats, oils and waxes, as fillers in the manufacture of tablets, pills and as base of any ointments, alginate is extensively used. An alginate guaze is used as a blood stoping plaster. As a slimming agent, the alginate forms a jelly in the sto-

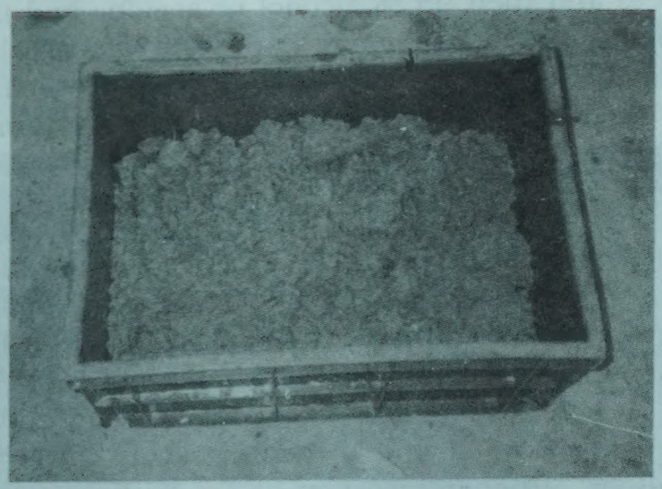

Fig. 6. Alginic acid seperated from the alkaly digested seaweed by centrifugation.

mach which produces the feeling of saturation in stomach. Ammonium alginate wool is used as a filter for microorganisms for laminar flowhood.

In cosmetic, detergent and soap making industries alginates serve as thickening and dispersing agents in the production of ointments, creams, liquid emulsions, lotions and toothpaste as weel as an additive in hair dye, hair fixing tonics, shampoos etc. due to the ability of alginates to form films. Alginates increase the consistency of shaving creams. In dental technology, alginates are used for making denture mouldings as well as denture fixatives.

In food technology, alginates improve the baking properties and they are constituent of baking emulsions. Alginates are used to make sugar glazings, egg, fruit and other cream fillings and in confectionary for making imitation fruits. Jelly products are made with water insoluble alginates (calcium alginates). In a number of countries alginates are suggested as a gelating agent in marmalades and jams. In dairy products such as cheese, creams, milk shake mixed in chocolates, puddings, cold prepared pudding powder, soft cheese and custards alginates are extensively used. Alginates act as stabilizers in milk mixes and impart uniform viscosity and good whipping ability.

In beverages alginates act as clarifying agents for making wines and raw liquor of sugar and molasses. Alginates act as foam stabilizers in lager beer and malt beer. In meat and sausage industry, meat and sausage products are given a longer shelf life with an alginate film. Artificial casings with as alginate base have been developed for making small sausages particularly for vegetarians. For deep-freezing of fish, meat and poultry products an alginate gel is used and this has been patented in many Western countries.

Alginate filaments are used in the production of calcium alginate rayons. In ceramic and leather industries, addition of alginates stabilizes the pigment and glazing suspensions to ceramic, porcelain and Chinaware as well as leather goods. Alginates find extensive application in textile industry particularly as a thickening agent for printing dyes and paints that prevents smudging and promotes quick drying and evenness of prints.

3. Carrageenan

Carrageenan is a sulphated galactan polymer obtained from various red seaweeds belonging to families such as Gigartinaceae, Solieriaceae and Hypneaceae. The term carrageenan comes from the name of the small coastal town Carragheen in Ireland, where commercial harvests of *Chondrus crispus* were made in the late 19th century.

Carrageenan (Fig. 7) differs from agar chiefly in its higher sulphated fraction and a higher ash

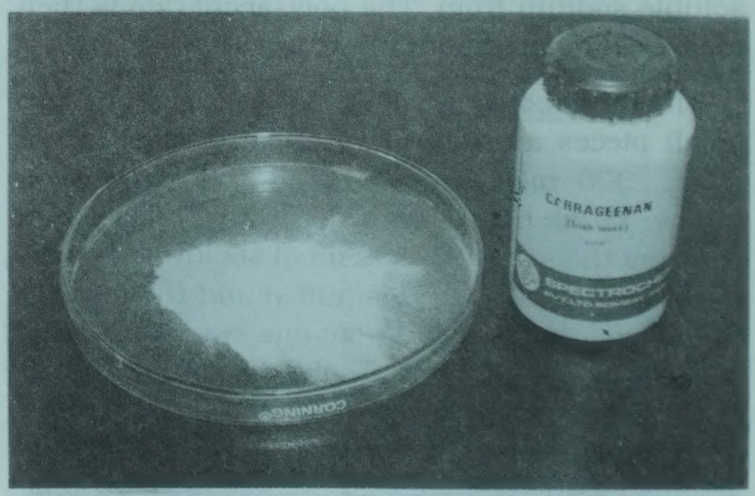

Fig. 7. Carrageenan powder.

content. The back bone of the carrageenan polymer consists of 1, 3- and 1, 4-linked D-galactopyranose units which vary in the degree and the location of sulphated esterification. Car-

rageenan can be separated into two fractions - k-carrageenan and λ-carrageenan whose polymer chain is branched in the former and linear in the latter. k-Fraction is separated from λ-fraction by precipitation with potassium choloride and amounts to 40 % of the carrageenan, the balance being the λ-fraction. The fraction soluble in hot water stands for k-carrageenan and the cold water soluble fraction to be λ-carrageenan.

Sources: *Chondrus crispus, Gigartina stellata, Iridaea* spp., *Eucheuma alwarezii, Kappaphycus* spp. and *Hypnea* spp. Fig. 8) are the chief raw materials for extraction of carrageenan.

Fig. 8. *Hypnea valentiae*, carrageenan yielding red seaweed.

Extraction: Ten g of seaweed is crushed and cooked for 4 hours at 90°C with 750 ml of water and 2g of CaO with occasional stirring. The hot extract is centrifuged for 5 min at 8000 rpm. The pellet is washed with warm water and centrifuged again. Save the supernatents each time and pooled together. The pH of the extract is adjusted between 8 and 8.5 with mild alkali solution. The alkaline supernatent is then added with 2 volumes of ethanol or isopropyl alcohol. The coagulam is collected either by filtration or by centrifugation at 5000 rpm for 5-8 min and dried at 50-60°C. The dry coagula are milled to obtain fine powder of carrageenan.

Uses: In food industry, carrageenan finds its use in bakery, confectionery and for culinery purposes especially in the preparation of condiment products, syrups, whipped creames, ice desserts, cheese etc. Carrageenan is used for clarification of beer, fruit juices and other beverages. Carrageenan improves the quality of wheat flour in *spaghetti* and *parotta* making. The food sector accounts for nearly 70 % of world market for carrageenan.

In pharmaceutical industry, carrageenan is used as emulsifiers in cod liver oil and emulsions as granulation and binding agents in tablets, elixirs, cough syrups etc. It is used extensively in ulcer therapy and for diseases of blood vessels. In cosmetics, carrageenan is applied as stabilizer and thickening agents in tooth-paste, skin ointments and solid air freshners. In textile industry, hot water extracts of carrageenan is used in printing designes with dye and act as finishing and sizing agents. Carrageenan, also called "Painters' Moss" has been used for some time in paint manufacturing as stabilizers for pigments. They are also good film-forming agents.

II. Seaweed as food

Seaweeds are not actually a sought after vegetable to most westerners. However, the orientals have been eating a veriety of seaweeds for thousands of years. It is known that about 100,000 tonnes of seaweeds are eaten annually in Japan in the name *Nori, Kombu (konbu)* and *Wakame.* Seaweeds are rich in proteins, vitamins, aminoacids, growth hormones, minerals and other trace elements. Hypothyroidism (goitre) can be cured and controlled by intake of iodine rich seaweeds like *Asparagopsis taxifirmis, Sarconema* spp. etc.

1. Nori

Nori is the name of various edible products derived from *Porphyra* after processing. Nori (Fig. 9) is prepared by harvesting porphyra, pounded,

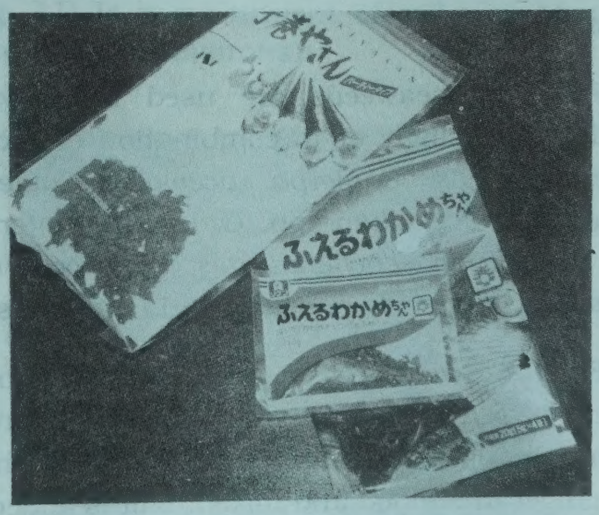

Fig. 9. Shredded *nori* strips ready for sale.

washed with water, drained, chopped and finally mixed with freshwater before being spread on bamboo mats for drying. When dried thin sheets of nori are obtained. These are pressed flat, stored and bundled and packed for marketing. Nori is used as a flavouring agent in soups, sauces and broths or even soaked in soyabean sauce and eaten with boild rice. Nori is also used in well known dishes- *tempura* and *sushi.*

2. Kombu

Kombu is prepared from *Laminaria.* After harvesting and drying the laminaria is separated from the stipe and hold fast are sorted for quality and sent to kombu factories. Kombu processing involves boiling the kelp in a green aniline dye solution, air drying, compressing in frames and then cutting into blocks which are shredded. Kombu is used as soupstock, boiled vegetable, snack or seasoning for rice dishes (as curry leaves are used in India).

3. Wakame

Wakame has become more popular in recent times. It is made from large brown seaweed *Undaria pinnatifida.* Undaria is processed as wakame by washing, desalting and drying. Desalting is achieved by boiling with water. Wakame is popularly known in the forms of roasted, or sugar candied products.

4. Salad

Following seaweeds are used for making salads either singly or in combination of two or three seaweeds. *Caulerpa racemosa, Caulerpa sertularioides, Codium* spp, *Gracilaria confervoides, Gracilaria eucheumoides, Hydroclathrus clathratus, Laurencia papillosa* and *Porphyra* spp.

Fresh seaweeds are cleaned of sand, debris, attached stones etc. and then washed in fresh water. Chopped tomatos, carrot, onion, chilly and ginger are added and mixed. Salt is added to the taset (Fig. 10).

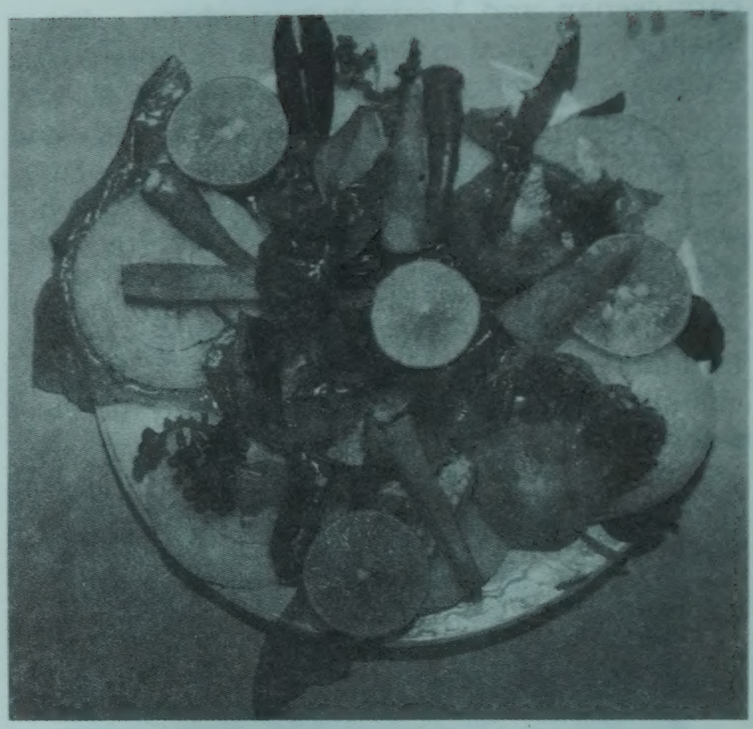

Fig. 10. Salad prepared from *Ulva lactuca* and *Caulerpa peltata.*

5. Seaweed masala

Materials	Quantity
Fresh seaweed, *Ulva lactuca* (washed and clean)	200g
Onion (big)	2 nos
Tomato	2 nos
Oil	2 teaspoon
Chilly Powder	1/2 teaspoon
Coriander powder	1/2 teaspoon
Turmeric powder	1/2 teaspoon
Salt, curry leaves, mustard and ginger	as desired

Cut onion and green seaweed into pices and garnish them in low fire with oil, mustard and curry leaves. When about to turn grey add the powders, salt, ginger and tomato pices and mix well. Serve hot. Good for rice and chappatis.

6. Seaweed pickle

Materials	Quantity
Fresh seaweed, *(Gracilaria edulis)*	500 g
Vinegar	500 ml
Chilly powder	2 teaspoons
Peeled garlic	10 nos
Mustard	1 teaspoon
Gingelly oil	100 ml
Fenugreek, asafoetida and salt	to the taste

Take cleaned fresh seaweed and remove moisture with cloth. Cut into small pieces. Soak in vinegar for 2 days. Remove from vinegar. Add gingelly oil, chilli powder, mustard and fenugreek powder. Season with asafoetida. Add peeled garlic. Mix thoroughly and bottle.

7. Seaweed wafer

Materials	Quantity
Dry seaweed meal *(Gracilaria edulis)*	150 g
Raw rice powder	100 g
Green chillies	6-8 nos
Gingelly seed	1 teaspoon
Cumin seed	1 teaspoon
Asafoetida and salt	to the taste

Boil cleaned dried seaweed in 2 litres of water. Filter through organdie cloth. Add raw rice paste, chilly paste and asafoetida powder. Add gingelly seed and cumin seed, and mix well. Cook together. Dry the paste in small lumps on cloth. Store in air tight jar before serving fried in oil.

8. Seweed porridge

Materials	Quantity
Dry seaweed meal *(Gracilaria edulis)*	100 g
Milk or coconut milk	3 Cups
Sugar	500 g
Cashew nut	50 g
Raisins	25 g
Cardamom	10 g
Edible grade colour	as desired

Boil dried cleaned seaweed in 1 litre of water for 20 minutes. Grind it into a fine paste. Boil the paste in 1 litre of water. Add sugar and milk. Mix thoroughly. Add cashew nut raisins and cardamom. Serve hot.

9. Seaweed jelly

Materials	Quantity
Dry seaweed meal *(Gracilaria edulis)*	200 g
Sugar	500 g
Lemon	5 nos
Edible essence and colour	as desired

Boil cleaned dried seaweed in 3 litres of water for 45 minutes. Stirr frequently. Filter through organdie cloth into a vessel. Add sugar, lime juice, essence and colour to taste in hot condition. Mix thoroughly. Pour in an enamel or stainless steel tray. Allow to set. Refrigerate for minimum 30 minutes. Cut into pieces and serve.

10. Seaweed jam

Materials	Quantity
Dry seaweed powder *(Ulva lactuca)*	100 g
Sugar	500 g
Edible colour and essence	as desired

Prepare sugar syrup. Add seaweed powder and boil for 15 minutes with stirring. Add edible colour and essence. Ready to serve

III. Seaweed as drugs and chemicals

More than 600 secondary metabolites belonging to the categories of terpenes, alkaloids, fatty acids and nitrogenous compounds have been isolated from marine algae. Many of these compounds are therapeutically active and have been extensively studied using laboratory and pharmacological assays. Species of *Sargassum* were used for cooling and blood cleansing effect. They contain sargalin, a blood sugar reducing agent. *Hypnea musciformis* is employed as vermifuge and *Centroceros clavulatum* as cathartic agent. Seaweeds rich in iodine such as *Asparagopsis taxiformis* and *Sarconema furcellatum* can be used to check goitre.

1. Mannitol

Mannitol is an important sugar alcohol of the hexite series found in brown algae. Mannitol (Fig. 11) is a constituent of cell sap. Mannitol occurs also as mannitan.

Fig. 11. Mannitol powder.

Sources: The chief raw materials for the extraction of mannitol are *Fucus vesiculosus, Laminaria hyperborea, Eklonia radiata, Bifurcaria brassiformis, Sargassum* spp. and *Turbinaria* spp.

Extraction: The dried brown seaweed materials are pretreated with dilute HCl (10-15 %). The aqueous acid extract after neutralization is evaporated to dryness. From this mixture of salts, mannitol and soluble polysaccharides the mannitol is extracted with boiling methanol for 5 hours in the Haanen and Badum extractor. The solution containing the extracted material is allowed to stand for 24 hours at 5°C and the precipitate–the crystalline mannitol is filtered and dried before weighing.

Sargassum johnstonii	-	Antimicrobial - inhibits the growth of *Pseudomonas, Proteus vulgaris*
Hypnea musciformis	-	Bactreiostatic and immunonodulator
Amphiroa fragilissima	-	Spasmogenic and hypotensive.
Lithothamnium californicum	-	GABA mimetic oligopeptides (Gama amino butyric acid), a neurotransmitter helps to settle bivalve larvae and induces morphogenetic changes in abalones
Hypnea musicformis Halmenia venusta and *Enteromorpha intestinalis*	-	Rich in saturated fatty acids mainly plamitic acid
Acanthophora spicifera	-	Antifertility activity
Ulva fasciata	-	Contains many sterols and an antiviral agent - UF 131. The structure of UF 131 is established as 2-N-palmitoyl, 4,5-dihydro 1,3,4,5- tetrahydroxy sphinogosine and exhibits antiviral activity against the Semliki Forest virus as well as the eusephlo mycocardiatis virus
Cladophoropsis zoolingeri and *Grateloupia lithophila,*	-	Strong haemolyic activity in rabbit blood.
Laurencia venusta	-	Antiviral property against *Herpes simplex* virus type-1 and vesicular stomatitis virus (VSV)
Caulerpa racemosa	-	Cytokinin a plant growth hormone
Schizymenia sp.	-	Antiviral substances effective against *Herpes simplex* virus and interfers with fusion between cells infected with HIV
Acanthophora spicifera and *Hypnea valentiae*	-	Heparin, a drug used in cardio–vascular surgery

Uses: In pharmacy, mannitol is applied for the production of tablets. Mannitol is also usd for making diabetic food, chewing gum etc. Mannitol is employed as dusting powder in the paint and varnish industry, leather and paper industry, pyrotechniques and in making explosives. In organic synthesis and in plastic production maniitol is used as plasticizers for the production of resins.

The names of a few more seaweeds and their bioactive properties are listed below.

It is evident that seaweeds from marine environment will from the basis of new products and services important to technology and utilization in the years to come.

IV. Seaweed as manure

The earliest record of utilization of seaweeds as manure was that of palladius in 4th century AD as described by Chapman (Chapman, V.J., 1980, In; *Seaweeds and their uses*, 62-97). It has been found that seaweeds contain many growth promoting harmones such as auxins, cytokinins etc apart from macro and micro–nutrients. Hence seweeds can be used as eco-friendly manures either as compost or the extract as liquid seaweed ferilizer (LSF).

1. Seaweed compost

Basal application of seaweeds as a green manure to coconut and other plantation crops along the Lakshadweep islands and coastal areas of Taml Nadu and Kerala is still in practice. This treatment improves the water holding capacity of soil, besides supply of micro and macro nutrients upon decomposition. A method for composting seaweeds with cow dung has been described by Thivy (Thivy, F. 1960, *Proc. Symp. Algology, ICAR*, 345-365). Field experiments have been conducted in the CMFRI applyin g seaweed compost to bhendi, sweet potato, tapioca and brinjal plants and high yields were obtained from these vegetable crops *(Bull. Cent. Mar. Fish. Res. Inst., 41).*

2. Liquid seaweed fertilizer

Now-a-days seaweed extract is made into mineral rich liquid seaweed fertilizer (known as

L.S.F.) and marketed under various trade names. Studies have proved that extracts of *Sargassum wightii, Ulva lactuca* and *Spatoglossum asperum* at 1 % strength show favourable response on the germination, seedling vigour, fruit setting and on the weight of fruit in crops like groundnut, maize, gingelly, tomato and ber. Liquid seaweed extract was first patented in the year 1912. Another patent was offered in 1962 and exploited by Maxicrop Ltd. and marketed as 'Maxicrop' and 'Bio-extract'. When foliar feeding became an orthodox method of plant nutrition in the 1950s 'Marinure', 'SM-3' and 'Trident' brands were made in the UK in the 1966s and 'Algifert' in Norway. In India SPIC is manufacturing and marketing LSF in the name of 'cytozyme' (Fig. 12).

Fig. 12. Cytozyme – a liquid seaweed extract marketed by SPIC Ltd.

Preparation of LSF

Following are the steps adopted in the preparation of liquid seaweed fertilizer.

Thoroughly wash the seaweed to remove sand, debris and other weeds. Dry seaweed. Pulverize the seaweed in a grinder. Soak the seaweed powder in water. Cook the seaweed for 2 hours with water in the ratio of 1:10. Filter and centrifuge the extract. The viscous filtrate is used as LSF. The filtrate is dried at 65-70°C to get dry solid. The dry solid extract is powdered and packed in air-tight bottles.

This powder can be used as LSF by making 0.5 % to 1.5 % (w/v) solution with water. This is used as a foliar spray on green canopy of leafy vegetables and other horticultural crops. Chemical Composition of LSF from *Sargassum* (Rama Rao, K., 1992, *Seaweed Res. & Utiln.*, **14:** 99-101) is given below.

Composition	%
Nitrogen	0.73
Phosphorous	2.00
Potash	3.00
Sulphate	6.10
Chloride	6.70
Silicate	0.20
Sodium	16.00
Lime	0.44
Iron	0.34
Aluminium	0.23
Copper	40.00 ppm
Cobalt	04.00 ppm
Iodide	0.90
Soda	18.90
Bromide	0.80
Magnesium	0.58
Zinc	100.00 ppm
Molybdenum	10.00 ppm
Manganese	40.00 ppm
Boron	01.00 ppm

V. Seweed as feed for farm animals

During the extraction of agar, the boiled extract is filtered to separate agar from the plant material. Indian seweed industries can extract only 50-60 % of the colloid content (10-20 %) from the raw materials. Hence the residue is known to contain considerable quantity of colloids, other carbohydrate, protein, vitamins and minerals. The residue remaining in the filter is normally discarded. This residue can be utilised as a feed for dairy, piggery and poultry or can be used as binder-cum carbohydrate substitute in the feed preparation for farm animals. As seaweeds contain may minerals and trace elements, meals prepared from seaweeds can be utilised as supplements to the daily rations of cattle, poultry, fish and other farm animals.

Seaweed meal prepared from *Gracilaria, Gelidella* and *Hypnea* is added to the feed ingredients while making compounded feed for fish and prawns as excellent binders. The commercial binders are gelatin and tapioca powders. Use of seaweed meal as a binder in fish and prawn feeds can increase the physicochemical standard of the feeds comparing to those feeds manufactured with conventional binders. Feeds made of seaweeds as binders help maintain water quality as the conventional binders get fermented easliy. Because of the flavour of seaweeds, these feeds have more platability and also they are enriched with minerals, aminoacids and carbohydrates. ❐

873 THE EELS AND EEL FISHERIES OF INDIA

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Introduction

Traditionally marketable species of eels are caught from conventional fishing grounds of northwest and northeast coasts of India and are largely a by-catch. They are considered a luxury food and consumed as a delicacy by Greeks, Romans, Germans, Japanese and people of several Asian and European countries, whereas in India eels are considered as poor man's food. But their export demand offers scope for culture and live transport to foreign markets, besides increasing their exploitation from all along the distributional range.

Eels are long-bodied, snake like fishes, having a crevice dwelling or sediment-burrowing mode of life, though some live in the pelagic realm of the open oceans. Though they are good swimmers, many eels are rather sedentary and rely on well developed sense of smell and large teeth to capture food, mainly crustaceans and small fishes. Eels are typical denizens of warm waters and are abundant on coral reefs. All eels, even the freshwater species, breed in the open ocean and spend their early part of life in the pelagic realm as flat, transparent, delicate larvae

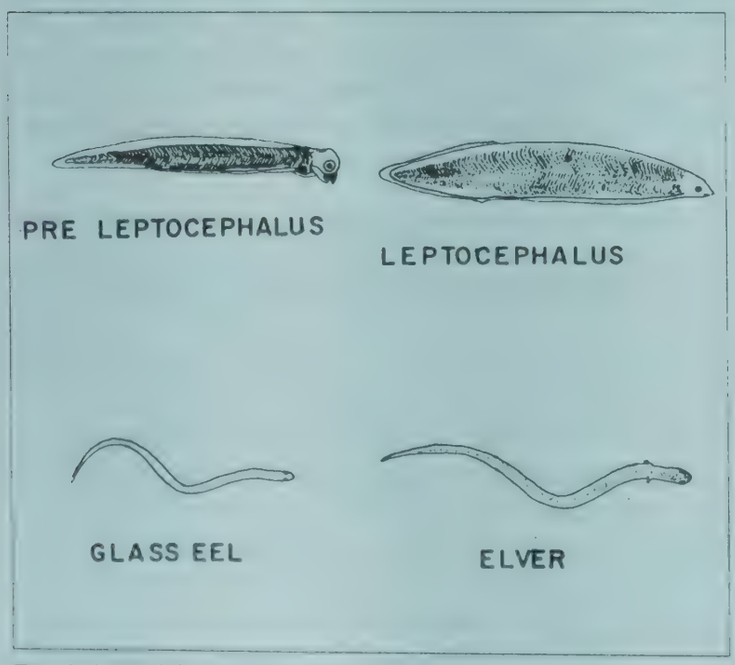

Fig. 1. Larval forms of freshwater eel.

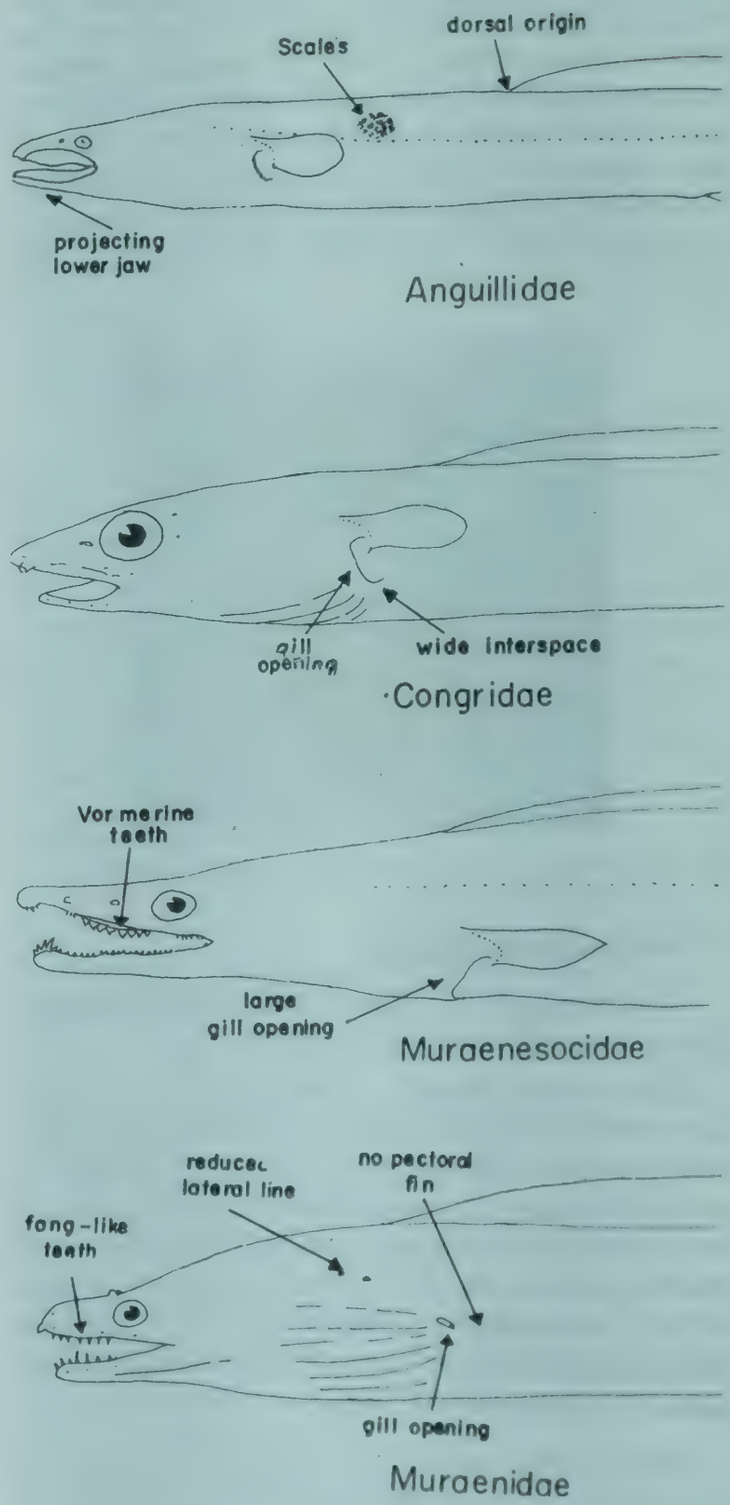

Fig. 2. Representative of major families of eels.

(leptocephali), which look different from their adults. The larva metamorphoses into elver before becoming adult (Fig. 1). The leptocephali form one of the important groups among the DSL biocomposition of the mesopelagic zone. They are abundant in the Arabian Sea off 1000 m depth zone. Eeels belonging to 18 species under 6 families are reported in the Indian waters. The diagrammatic characters of the four commercially important families are depicted in Fig. 2.

Vernacular names

The eels are known as *wam* in Gujarat and Maharashtra; *aarel, kariaarel* in Kerala; *vilangu, kulivi pambu* or *kadalpambu* in Tamil Nadu; *nallapamu, talabon, tellapamu, pasupu pamu* in Andhra; *dantia sapu, lahantara, pantisapa, sata hali* in Orissa and *samudra bera, berua, bam, sona bam* in West Bengal.

Brief biology and ecology

1. Anguillidae : Fresh water eels

Freshwater eels actively forage at night, feeding on a wide range of small bottom-dwelling invertebrates. They breed in the open oceans and the currents drift the young larvae (leptocephali) towards coast, where they metamorphose into tiny, transparent elver stage and enter rivers.

Anguilla bengalensis bengalensis (Gray, 1831) grows to a size of 120 cm and *Anguilla bicolor bicolor* McClelland, 1844 grows to 80 cm are the two species of anguillidae in India.

2. Congridae : Conger eels

Uroconger lepturus (Richardson, 1848) is the only species in this family from Indian waters, which grows upto 40 cm. Conger eels are denizens of tropical to temperate waters from the coast to the deep sea an soft sandy mud bottom feeding mainly on small bottom dwelling crustaceans.

3. Muraenesocidae : Pike congers

Pike congers occur in tropical waters in the soft bottoms upto 100 m depth and in estuaries. The shallow water species are apparently nocturnal and feed on bottom living fishes and crustaceans. *C. talabonoides* and *M. cinereus* are common in Maharashtra and Gujarat during monsoon months. Four species are recorded in Indian waters and they grow to a maximum length of 80 cm *(Congresox talabon)* (Cuvier, 1829), 250 cm *(C. talabonoidies)* (Bleeker, 1853), 180 cm *(Muraenoox bagio)* (Hamilton-Buchanan) and of 80 cm *(M. cinereus)* (Forsskal, 1775)

4. Muraenidae : Morays

The largest known eel, *Thyrsoidea macrura* (Bleeker, 1854), which grows to 400 cm belongs to this family. Morays inhabit shallow waters of tropical seas. Although a few species invaded rather deep water (over 200 m) and some others occur in temperate areas they are most abundant on reefs or in rocky areas where they find protection in holes and crevices. They are scavengers and predators which become active at night in reef flats and feed on small reef animals, particularly crustaceans.

Thyrsoidea macrura (Bleeker, 1854) – 400 cm; *Echidna nebulosa* (Ahl, 1789) – 80 cm; *E. zebra* (Shaw, 1797) – 150 cm; *Lycodontis meleagris* (Shaw & Nodder, 1795) – 120 cm and *Siderea picta* (Ahl, 1789) – 140 cm are the species and their recorded maximum size.

5. Ophicthidae : Snake eels and Worm eels

These are occurring mostly in tropical and sub-tropical waters between the shore line and depths to below 75 m. Many species are benthic and borrow partially or totally in the bottom at least for part of the day. They inhabit estuaries and inshore area of turbid water, lagoons and some species enter fresh water and paddy fields. They feed on small, sand-dwelling invertebrates.

Caecula pterygera Vahi, 1794, *Lamnostoma orientalis* (McClelland, 1844) and *Neenchelys buitondijki* Weber & de Beaufort, 1916 grows to a length of 30 cm. The other two species, *Pisodonophis boro* (Hamilton-Buchanan, 1822) and *P. cancrivorus* (Richardson, 1844) grow to 100 and 75 cm respectively.

6. Ophidiidae : Cusk eels, Brotulas

Only one speces, *Brotula multibarbata* (Tem-

minck & Schleged, 1846) is the representative of this family. Adults are bottom dwelling, on the continental shelf and slopes, down to 650 m depth; early stages are pelagic and are usually found in reef areas. It grows to a size of 50 cm.

Present status of fishery

The catch : the estimated annual landings of eels during 1976-'95 has ranged from 4,309 t to 12,997 t with an average of 7,277 t. Despite the intensification of trawling, the catches have declined in recent years. (Fig. 3). Five yearly average

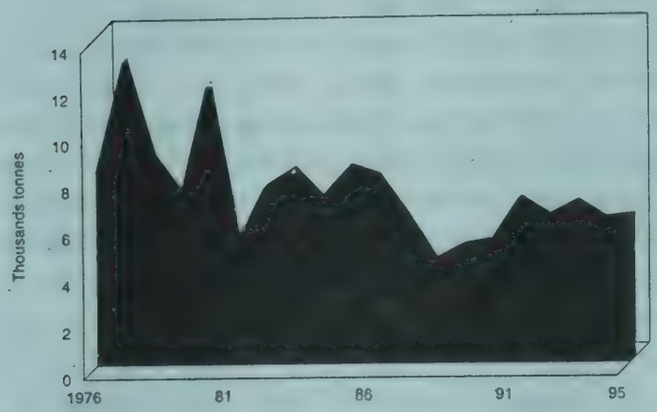

Fig. 3. All India eel catch during 1976-'95.

catch showed that it was high during 1976-'80 (9,832 t) and gradually declined in 1981-'84 (7,234 t) and 1985-'90 (5,676 t) and showed a slight revival in 1991-'95 (6,366 t).

Although eels occur in the landings of almost all maritime states, 82 % of the total catch (1976-'95) comes from the northwest coast (Gujarat and Maharashtra). The northeast coast (Andhra and Orissa) contributes 13% of the catch. The average (1991-'95) catch composition of the maritime states is given in Fig. 4.

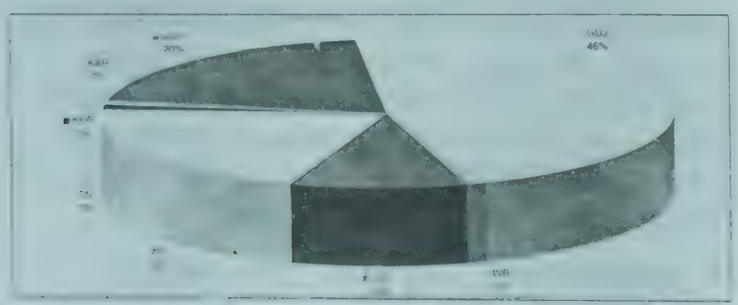

Fig. 4. Statewise eel landings (percentage).

From the landing data, it is evident that the eel production decreases in the northwest while it increases in the northeast (Fig. 5 and 6). Five

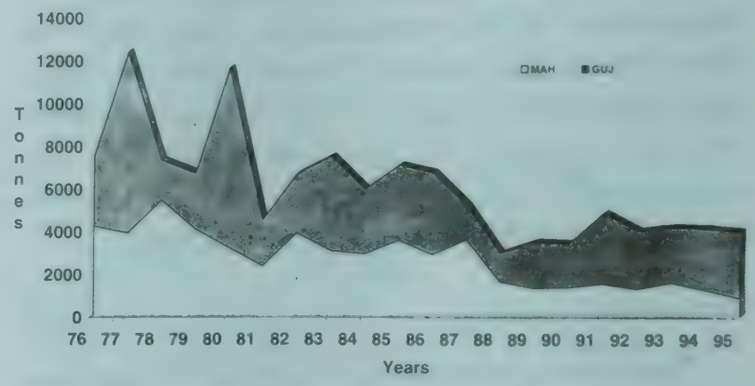

Fig. 5. Eel landings of Maharashtra-Gujarat during 1976-'95.

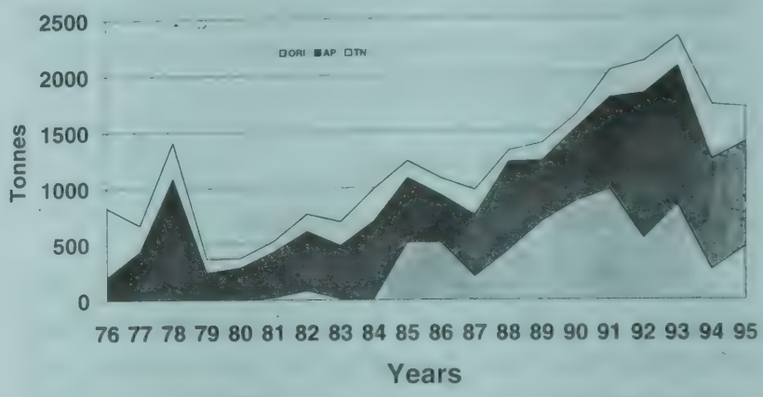

Fig. 6. Eel landings of Orissa, Andhra Pradesh and Tamil Nadu during 1976-'95.

yearly statewise composition showed that the percentage contribution of eel is stable in Gujarat, declined in Maharashtra and increased in orissa and Andhra (Fig. 7).

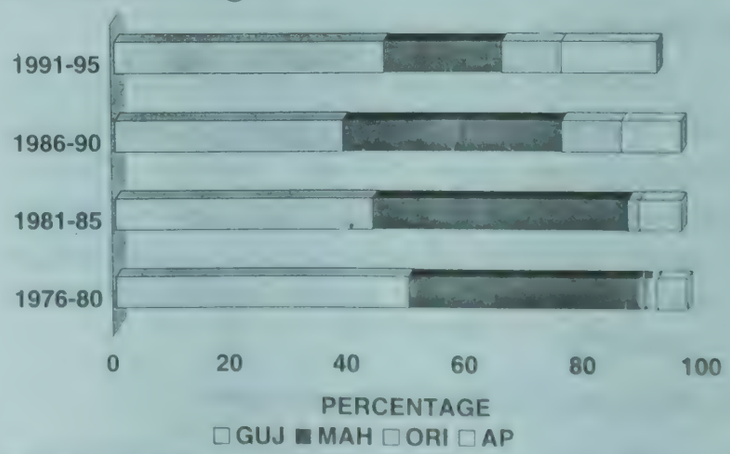

Fig. 7. Five yearly average catch of eels of different maritime states.

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Fishing methods : Eeels are most commonly fished by trawl net (70 % catch) followed by non-mechanised gear (13 %) (Fig. 8). However, fishing

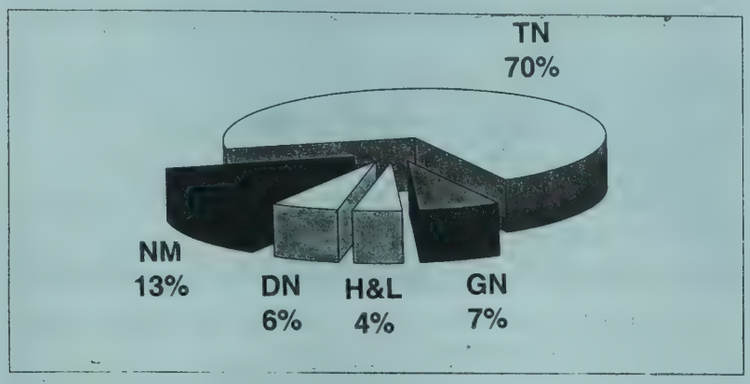

Fig. 8. Gearwise all India eel catch.

methods differ from coast to coast. State wise major gear which contribute the eel catch are given in Fig. 9.

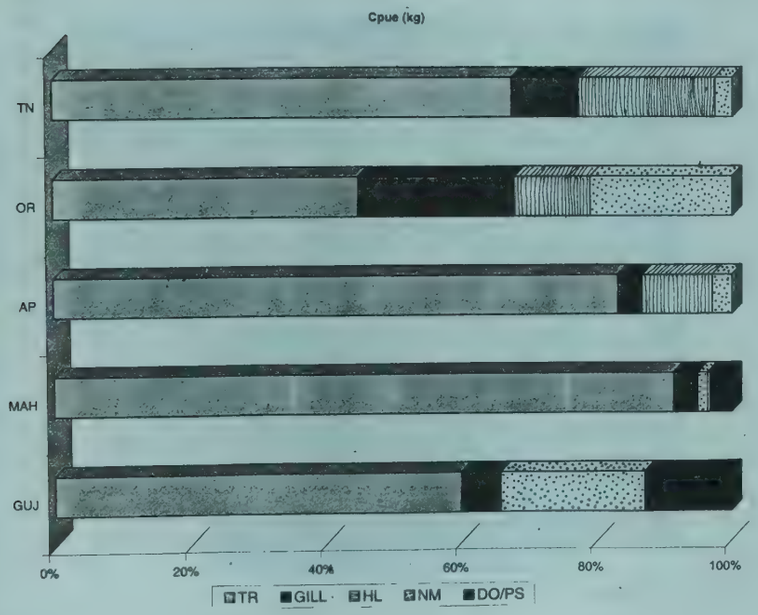

Fig. 9. Statewise eel catch in different gear.

Fishing grounds and season : The eel fishing grounds are located off Cambay, Veraval and Kutch. They are available throughout the year and better catches are realised during May-September.

Depthwise distribution : They prefer the depth range 16-20 m. & 52-60 m Their cpue along the trawling grounds off Gujarat -Maharashtra, based on exploratory survey reports, is given in Fig. 10. Bapat *et al., (Bull. Cent, Mar. Fish. Res. Inst.,* No.33, p. 86, (1982) reported that the depth range 55-90 m was the most productive area in the above mentioned grounds. Pelagic trawling yielded a catch rate of 12.8 kg/hr from 55-90 m depth during January and February.

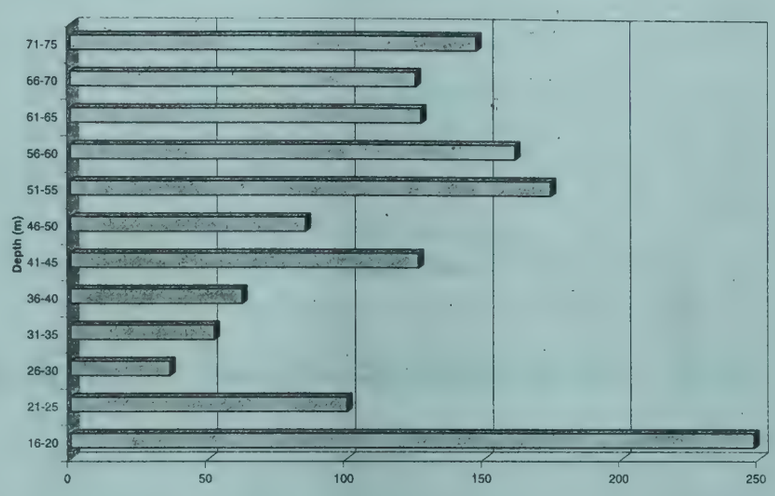

Fig. 10. Depthwise ell catch (Bombay-Gujarat).

Economic Importance

Utilisation : Eels are an important source of food in many parts of the world. Many Asian countries pay significant premiums for live product. The international eel market worth more than 75 million British pounds in 1976. In Europe the trade is catagorised into five distinct areas, namely elvers (baby eels); fingerling eels; captured eels; cultured eels and fresh and processed eels. It can be marketed in a variety of value added forms; whole, filleted, steaks, smoked, cured, marinated etc. Fillets individually wrapped in polythene, shrink packs in polystyrene trays, vaccum packs, skin wrapped or packed in a modified atmosphere have a good market in Hongkong. Fillets are also presented in battered and breaded form. "Frozen alive" kept in polythene bags (12 kg), filled with oxygen and ice, have a good market in Hongkong. Eel flesh can also be used as the raw material for manufacturing of fish sausage and ham. The Central Institute of Fisheries Technology has developed technologies for somked eel fillets and smoked and canned eel fillet. Their air bladders yield good quality isinglass.

In Netherlands and Germany, smoked and

jellied eels are considered a great delicacy while in the Far East live eels are prefered. Europe and Far East annualy produce about 20,000-25,000 t of eels during 1976. The latter is the main area of eel culture and the former the wild eel capturer.

The small sized live eels are used as a bait for long line and hooks and line, preferably for shark fishing. The colourful spotted or stripped eels could be maintained in aquarium as ornamental fish.

Several species are cultured in Asia and Europe. A suitable culture technology for the Indian short-finned eel, *Anguilla bicolor bicolor* has been developed by CMFRI besides live elver collection and their transportation. The average time taken to fatten the Japanese eels to market size, 5-6 pieces per kilo is 12 months; whereas it needs 14 months for the European eels.

A suitable management strategy is imperative to achieve sustainable harvest from their distribution range. Their live export and development of suitable consumer preferred value added products would fecilitate export. ❐

874 THE MARINE AQUARIUM OF CMFRI AT VIZHINJAM IN TRIVANDRUM, KERALA

The CMFRI has established one marine aquarium at one of its Research Centres at Vizhinjam. It is situated about 15 km south of Trivandrum and about 2 km from Kovalam International Tou-

Fig. 1. Sea anemon

rist Centre. The aquarium has displayed the hidden coral paradise by recreating the habitat in its natural from. Enchanting beauty of the fascinating, ever-changing and colourful world of corals and coral reefs which is inhabited by the world's most colourful invertebrates and fish species is exhibited at the aquarium. The animal diversity ranges from colourful sponges, a variety of curious animals to fishes and turtles. The varieties of sponges, corals, sea anemones, sea-fans, marine worms, sea snails, oysters, clams, mussels, shrimps, prawns, lobsters, crabs, starfi-

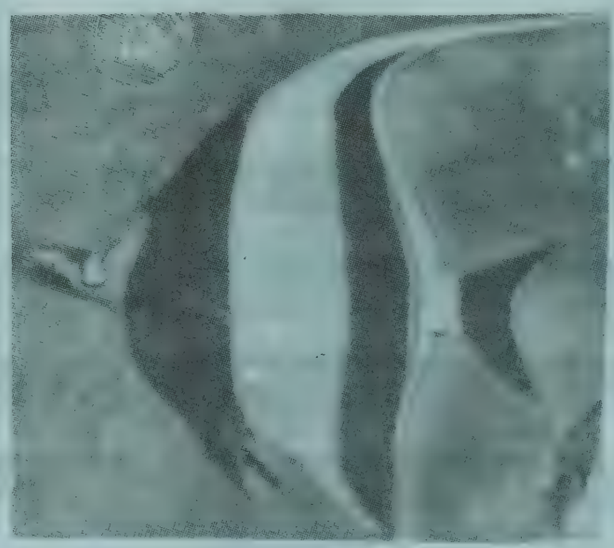

Fig. 2. Flower fish

shes, sea cucumbers and seaurchins expose the wonders of the coral reef habitat to the visitors.

The exhibits

The ***doctor shrimp*** is a beatifully-coloured shrimp which removes ectoparasites and dirt from the corals and maintains the health of the coral colonies. The lower forms of animal life ***sponges, sea anemones*** and ***seafans*** are exciting to watch. The **starfishes** are not fishes, but they belong to the group of echnioderms. The ornamentations of the different species of starfishes and their slow movements with the help of hundreds of tiny pegs called tube feet are rare sights. The ***seacucumbers*** and ***seaurchins*** are

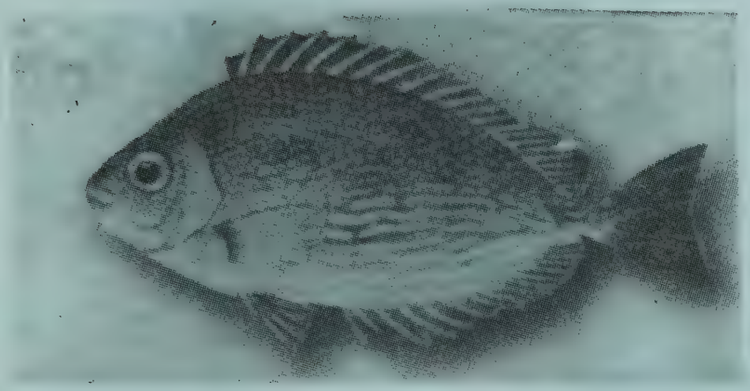

Fig. 3. Rabbit fish

also echinoderms.

Different species of **bivalves** and **sanils** with curious shells are abundant in the habitat. The ***giant clam*** is peculiar to the coral reef environment. Commercially important crustaceans such as **prawns, lobsters** and **crabs** are very interesting to watch in the aquarium. Their colour patterns, ornamentations and peculiarities of movements are fascinating.

Fig. 4. Surgeon fish

The world of marine ornamental fishes exhibited at the aquarium provides the visitors an opportunity to see the most diverse forms, colours and habits. Watching them in the aquarium relieves us of the tensions of daily life.

Fig. 5. Wrass

One of the most fascinating among all tropical marine aquarium fishes is the **anemone fish** or **clown fish** that lives in association with seaanemones. The clown assists in feeding the host anemone by storing their excess food among its tentacles, thus ensuring a steady supply of food. The clown has acquired natural protection from paralysing filaments of the anemone with a mucous layer that covers the body of the fish. The **surgeon fish** owes its name to the sharp, knife like spine on each side near the tail. In most species the spines are folded into a groove normally, but they are lifted when the fish is distrubed or excited, and used as weapons for inflicting slash wounds on the victims. The **parrotfishes** have heavy parrot like beak which is formed of fused teeth. The sharp and powerful beak is used for crushing the hard outer skeletons of

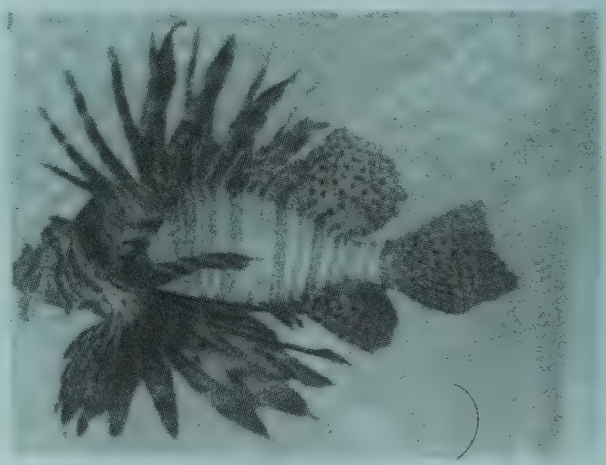

Fig. 6. Lion fish

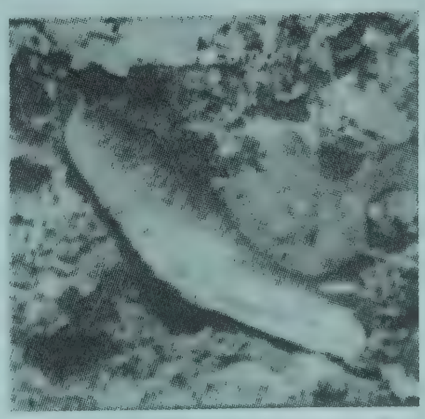

Fig. 7. Sea-cucumber

the reef-forming corals to get at the soft animals inside. **Squirrel fishes** are attractive with redcoloured body, white stripes and yellow fins.

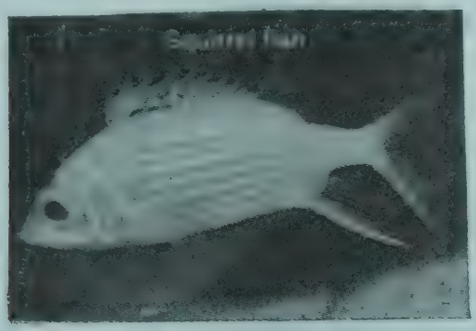

Fig. 8. Squirrel fish

The **triggerfishes** are brightly coloured and they can lodge themselves immovable by erecting the first dorsal spine and locking it in place. The **boxfish** has a hard outer case that completely encloses the body. The **pufferfish** has the ability to inflate its body by quickly gulping in water and

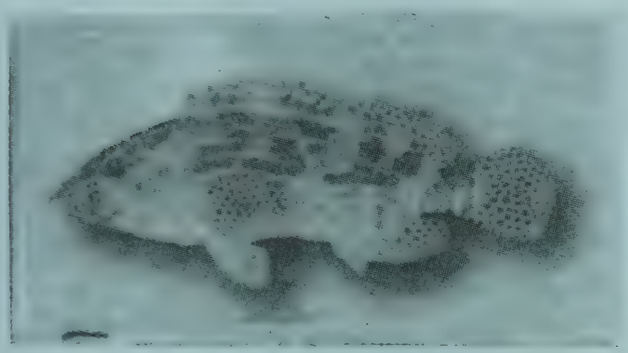

Fig. 9. Grouper

then turning upside down so that it floats on the surface. It can expel the water rapidly to return to the normal size and position. This sudden bloating is sufficient to dispel the enemy. The **porcupinefish** resembles puffers and it is also able to inflate its body. It has long, sharp spines over the body which can inflict wounds.

The **butterfly fishes** are so called because of their active flitting movements and bright colours. **Angelfishes** which are equally charming are larger and swim more slowly with exceptional grace. The **lionfish** is the wild beauty of the aquarium. All the spines in the first dorsal fin are stout and sharp, the first few of which are hollow, serving as hypodermic needles that inject poison into the stab wounds. The **sea-horse** is a

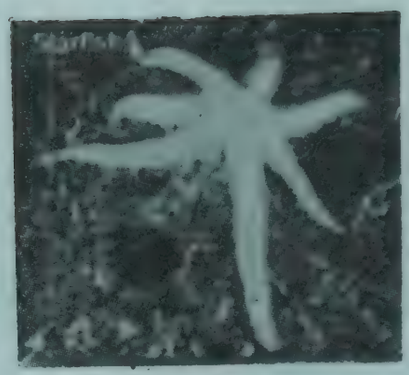

Fig. 10. Starfish

peculiar fish that is completely different from the typical fish shape. The head is bent down, joining the body almost at right angles, swims in an upright position, stiffly but gracefully. Its long prehensile tail is used for holding onto sea weed or

Fig. 11. Sea-horse

other objects. The female lays her eggs in a pouch on the male. The young ones emerge as miniature adults from the pouch. The **moorish idol** is one of the most spectacular reef fishes. The snout is projected and tube-like. Both the dorsal and anal fins are long and swept back.

The world of coral reef habitat which is the abode of hundreds of species of colourful ornamental fishes and other organisms is a delicate and dynamic ecosytem which needs to be conserved. The indiscriminate exploitation of these ornamental fishes from the habitat will damage the ecosystem and the coral paradise will become a graveyard of these fishes. The entrepreneur venturing into ornamental aquarium fish trade needs scientific training for the judicious exploitation of these fishes, for maintaining them in tanks with proper feeding and for installation of efficient filter systems to sustain the water quality.

In addition to the marine ornamental fishes,

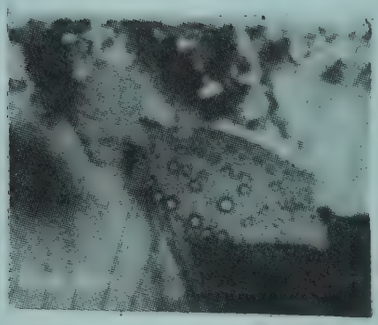

Fig. 12. Box fish

the aquarium displays a few fresh water fishes like the famous **piranha, crocodile sucker cat, firemouth, spiny eel, oscar** and **koi carp,** apart from brackish water fishes such as **pearl spot** and **tilapia.**

Fig. 13. Doctor shrimp

The aquarium provides an unique opportunity for students and tourists to study and enjoy the underwater life of the coral seas.

875 On the landing of an olive ridley turtle at Kanyakumari, Tamil Nadu and updated record of incidental catches of sea turtles in India

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Introduction

Five species of the sea turtles, *Lepidochelys olivacea* (Olive ridley turtle), *Chelonia mydas* (Green turtle) *Eretemochelys imbricata* (Hawksbill turtle), *Caretta caretta* (Loggerhead turtle) and *Dermochelys coriacea* (Leatherback turtle) are found along the coasts of India including Lakshadweep, Andaman and Nicobar Islands. In India directed olive ridely fishery existed in Orissa and West Bengal during the 'arribada' and green turtle fishery in Gulf of Mannar and Palk Bay in Tamil Nadu. However, fishing and trading of turtles were totally stopped in the early 1980 in Tamil Nadu and in 1983 in Orissa and declared turtles as endangered species. Since then turtles were landed as incidental catch of different gear along the Indian coasts in the fishing operations. Recently, an account of incidental catch of the sea turtles has been published by Rajagopalan *etal.*, (1996).

The turtle landed at Kanyakumari

A female turtle was caught in a gill net operated off Kanyakumari, on 24.8.'96 which was identified as *Lepidochelys olivacea* (Fig.1). The morphometric measurements (in cm) of the olive ridely are presented below.

Fig.1. *Lepidochelys olivacea* landed at Kanyakumari.

Total length	79
Carapace length	60
Carapace width	62
Plastron length	43
Plastron width	33
Head length	19
Front flipper length	33
Front flipper width	8
Hind flipper length	24
Hind flipper width	8

Earlier reports of incidental catches of sea turtles

Incidental catch of sea turtles by the fishing gear like trawl and gillnet, the use of which has increased during the last one decade, is a major problem. The reported incidental catches so far reported are given in Table 1. Unfortunately no report about the accidental

TABLE 1. *Earlier reports of accidental catches of different species of sea turtles in India*

Date	Place	Species					Total	Sex	Measurements (cm)				weight	Gear	STR	References
		OR	GT	LB	HB	LH			CL	CW	PL	PW				
2-9-1981	Bombay				1		1	F	78.3	61.3	43.8	–	80 Kg	GN	–	Karbhari 1981
28-3-1985	Kovalam, Madras			1			1	F	–	–	–	–	–	–	1	Rajagopalan 1983
5-4-1985	Malvan			1			1	M	149.8	109.0	142.0	72.5	100 kg	GN	–	Karbhari *et.al.* 1986
1-4-1984	Bombay	1					1	M	63.0	60.0	50.5	48.0	48 Kg	TN	–	- do -
18-9-1984	Bombay	1					1	F	75.0	59.0	52.0	49.1	55 Kg	TN	–	- do -
13-12-1985	Ratnagiri		1				1	M	51.2	44.9	–	–	38 Kg	TN	–	- do-
19-4-1984	Bombay		1				1	F	66.5	56.8	51.2	47.2	43 Kg	BN	–	- do -
1-4-1985	Malvan			1			1	NK	149.8	109.8	142.5	72.5	–	GN	–	Karbhari 1985
7-1-1988	Pamban	7					7	NK	61.01	51.2	–	–	–	TN	–	Kasinathan 1988
9-1-1988	Pamban	6					6	NK	70.01	47.2	–	–	–	TN	–	- do-
3-7-1988	Mandapam			1			1	M	152.0	81.0	144.5	83.0	260 Kg	GN	–	Rao *etal.* 1989
14-2-1988	Rameswaram			1			1	F	162.0	86.0	151.0	51.0	300 Kg	TN	–	Pillai *etal.* 1989
14-2-1988	Pamban	1					1	NK	67.0	56.0	51.0	48.5	–	TN	–	- do-
18-4-1988	Ratnagiri	3					3	NK	57.0	–	–	–	–	TN	–	
19-4-1988	Ratnagiri							60.0	–	–	–	–	–	GN	–	Katkar 1989
3-5-1991	Ratnagiri	3	–	–	–	–	3	M(1) NK(2)	68.5	–	–	–	–	BN	–	Jayadev, S. Hotagi 1992
3-3-1991	Kolachal				1		1	F	173.2	132.4	154.7	86.0	250 Kg	BS	–	Ebenezer & Joel 1992
10-3-1991	Rameswaram				1		1	F	174.0	120.0	–	–	350 Kg	TN	–	Pillai *et al.* 1995
20-4-1994	Thondi				1		1	NK	45.0	–	–	–	–	–	1	Ganapathy 1994
27-11-1995	Ratnagiri	2					2	NK	64.0	60.0	–	–	30 Kg	H&L	–	Katkar 1996
2-5-1996	Janjira Murud	1					1	NK	71.0	52.0	57.0	57.0	56 Kg	–	1	Jadhav 1996
24-8-1996	Kanyakumari	1					1	F	60.0	62.0	43.0	33.0	–	GN	–	Present observation
3-2-1997	West Bengal					2	2	M&F	83.0 83.0	58.0 53.0	– –	– –	70 Kg –	– –	2 –	Swapan Kumar Kar 1997
21-2-1997	West Bengal					1	1	M	–	58.0	–	–	75 Kg	–	1	-do-

OR : Olive ridley, GT : Green turtle, LB : Hawksbill; C L : Carapace Length, CW : Carapace width
PL : Plastron length, PW : Palstron width; GN : Gillnet, T N. : Trawlnet, BN : Bagnet, BS : Boat seine; STR : Stranded.
M : Male, F : Female, NK : Not known.

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TABLE 1. *Reported incidental catch of turtles in different states (in nos and %)*

Place	No. of turtle	Percentage
Tamil Nadu		
Pamban	14	66.6
Rameswaram	2	9.5
Mandapam	1	4.8
Thondi	1	4.8
Madras	1	4.8
Kanyakumari	2	9,5
Maharashtra		
Ratnagiri	11	68.5
Bombay	3	19.0
Malvan	2	12.5
West Bengal		
Digha	2	66.3
Mohana	1	33.3

catches of turtles in Kerala and Andhra have been reported. Yearwise (1983-'92) statistics of incidental catches of adult olive ridley in Gahirmatha Orissa have been reported by Rajagopalan *et al.* (1996).

From Table 1 it is seen that olive ridley the most abundant species in India formed 65 % of turtle landings followed by leather back turtle, popularly known as *eluvari ammai'* or thoni ammai in Tamil. This is the rarest, and the largest sea turtle in India and occupied the second place (17.5 %) in the incidental catches.

The green turtle *Chelonia mydas* called '*peramai*' in Tamil and found in Tuticorin and Gulf of Manner is herbivorous and is highly priced. It formed 5 % of the incidental catches. Turtle meat, oils and shells were exported to different countries in the past. Hawksbill turtles a comparitively small sized turtles is less abundant in the Indian waters compared with others. Its flesh is reported to be poisonous in Punnaikayal, Manapad, Tuticorin, Kanyakumari and Sakthikulangara areas. It formed 5 % of the incidental catches. The logger head is characterised by a large head in relation to body size. It formed 7.5 % in the incidental catches.

Gearwise incidental catch

Among the reported incidental catches, 45 % of the sea turtles were caught in trawlers, followed by gillnet 20 % (Table 2). In Maharashtra turtles were caught accidentaly mostly in 'dol' net and formed 12.5 %, and in hooks and line and boat seines they occupied 12,5 % and 2.5 % respectively. The stranded specimens formed 15 % . On two occasions the incidently caught turtles were released back into the sea (Jayadev, 1992).

Among the reported incidental catches 52.5 % were reported from Tamil Nadu, 40 % from Maharashtra and 7.5 % from West Bengal. Of the reported cases in Tamil Nadu 80.9 % were reported in Pamban and nearby areas and in Maharashtra 68.5 % were reported from Ratnagri.

Sex

In the reported incidental catch (Table 2) the females and males formed 22.5 and 17.5 % respectively. In 60 % of the reported instances the sex was not mentioned.

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876 A note on chank fishery in Gulf of Kutch, Gujarat

The Sacred chank, *Xancus pyrum* var. *acuta* (Bolten) is exploited commercially from the intertidal and reef habitat in the Gulf of Kutch along the Jamnagar District. Important centres of collection are Okha, Salaya, Aramda, Poshitra, Badia Is., Nora Is., Bharana, Vadinar, Sikka, Pirotan Is., Bedi, Adatra, Beyt Balapur and several small centres in the Gulf of Kutch (Fig. 1).

Fishery is mostly done by hand picking at low tides in the intertidal zones. The Sindhis, Vadhers, Medhwars and other local communities are involved in this work. Now-a-days most of the fisherwomen are also engaged in this, to enhance their economic standards. Around 50 to 60 fisherwomen are engaged in the Okha Mandal area. The annual chank production during 1975 to 1985 varied between 1,114 and 20,899 numbers, averaging 8,726. The highest yield of 20,899 nos was recorded in 1984-'85. From 1985 onwards there has been a decrease in chank production, average annual yield being 3,362 nos. Table 1 indicates the chank production in the Jamnagar district of Gujarat during 1995-'97 period.

Fig. 1. Important centres of chank fishery in Jamnagar Dt. of Gujarat.

TABLE 1. *Production of chank during 1975-'97 period*

Year	Large	Medium	Small	Worm eaten	Total
1975-'76	1,185	6,644	192	2,368	10,389
1976-'77	122	776	12	204	1,114
1977-'78	196	1,223	10	1,153	2,582
1978-'79	1,002	4,702	194	1,372	7,270
1979-'80	465	2,126	157	1,761	4,509
1980-'81	340	2,549	1,050	2,162	6,101
1981-'82	262	1,372	5,134	3,561	10,329
1982-'83	385	1,592	4,697	4,233	10,907
1983-84	534	2,633	6,639	4,554	14,360
1984-'85	271	2,063	8,667	9,898	20,899
1985-'86	64	639	3,276	3,552	7,531
1986-'87	117	1,045	7,874	2,031	11,067
1987-'88	37	354	2,143	408	2,942
1988-'89	38	285	2,340	593	3,257
1989-'90	19	287	1,651	835	2,792
1990-'91	5	177	2,044	1,040	3,266
1991-'92	5	136	1,671	932	2,744
1992-'93	9	63	824	1813	2709
1993-'94	13	184	2,017	827	3,041
1994-'95	7	109	2,092	1,037	3,245
1995-'96	6	79	593	447	1,125
1996-'97	nil	15	575	208	798

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The chanks collected are graded according to diameter as large: 10 cm & above, medium: 8-10 cms, small: 6-8 cm, worm eaten and under sized and are purchased by Fisheries Office, Govt. Of Gujarat at fixed rates according to the size. These chanks are then auctioned mostly to Calcutta based cottage industries. The Table 2 indicates the prices prevailed during 1980 and 1977.

TABLE 2. *Prices per chank in 1980 and 1997 compared*

Size dia. (cm)	Price (Rs)/piece	
	1980	1997
10 & above (big)	4.00	10.00
8-10 (medium)	3.50	7.00
6-8 (small)	2.50	6.00
Worm eaten	0.80	1-2.50

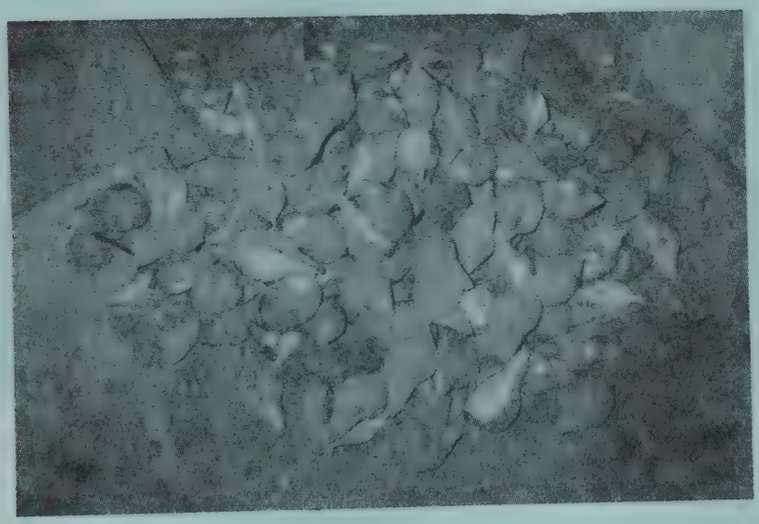

Fig. 2. A Collection of chanks.

Fig. 3. A few specimens of chanks enlarged.

Although this is a highly priced item and private entrepreneurs are willing to pay high prices for it, production trends over the last few years give reason for concern. The sudden decline in production from 1987 onwards may be either due to depletion of resource due to over-exploitation or disinterest on the part of the fishermen caused by the nominal government rates of purchase. Detailed investigations are essential to analyse the real cause for decline in production and to study the possibility of reviving/extending chank fishery in this area.

Reported by : Sujitha Thomas, Joe, K. Kizhakudan and B.V. Makadia, Veraval Research Centre of CMFRI, Veraval-362 265, India.

877 A record of sun fish *Mola mola* from coastal waters at Veraval

TABLE 1. *Morphometric measurements (in mm) of* Mola mola caught at Veraval

Particulars	Fish specimens			
	1	2	3	4
Total length	1,000	870	1,030	900
Breadth at the middle region	650	620	700	750
Weight (kg)	46	40	49	43
Length of dorsal fin	440	430	450	400
Length of anal fin (mm)	410	400	420	400
Snout to anal fin insertion	780	660	800	660
Snout to dorsal fin insertion	640	560	660	610
Eye diameter-horizontal	50	50	50	50
Eye diameter - vertical	40	40	40	40
Pectoral fin base breadth	50	50	50	45
Dorsal fin base breadth	200	150	200	160
Anal fin base breadth	170	160	170	160
Snout to insertion of pectoral	300	300	300	280
Length of gill slit	50	50	50	50
Inter-orbital distance	280	260	280	260
Dorsal fin tip to anal fin tip	1500	1300	1500	1400
Pectoral fin length	140	100	140	120
Eyeball to snout	150	140	150	150
Sex	Male	Male		
Liver weight (g)	1000	1250		
Gut length (m)	2.29	2.60		
Gut length-body length ratio	2.39:1	2.50 : 1		

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Fig. 1. Sunfish *Mola Mola* landed at veraval.

Fig. 2. One of the specimens being weighed.

Fishes belonging to the family Molidae, commonly called as ocean sun fishes or head fishes and known as 'Kakhida' locally, are frequently observed in the trawl net landings at Bhidia fish landing centre of Veraval, mostly during the post-winter months. Though they are known to occur widely in warmer oceanic regions and inhabit open waters upto 200-300 m depth, the present report is on speciments caught from the coastal waters. These fishes occur either solitary or in small schools and are known for their peculi

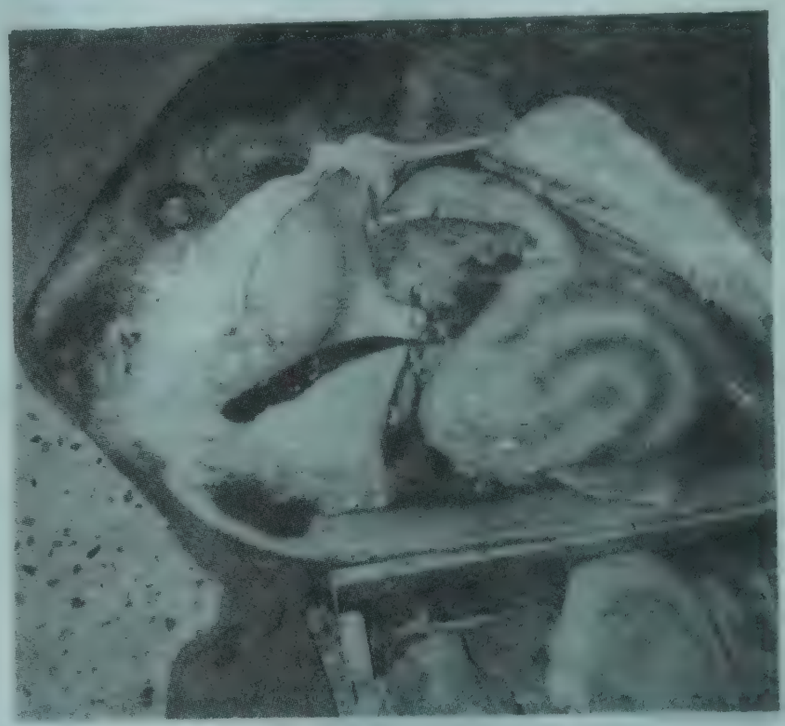

Fig. 3. Sunfish cut open showing the coiled intestine, gill chamber, gill lamellae and the sucker fish.

Fig. 4. The uncoiled intestine of *Mola mola*.

ar drifting nature. Three general of this family have so far been identified, namely, *Ranzania, Masturus* and *Mola.*

Four male sun fishes, (Linnaeus, 1758) were caught by trawl nets operating off Veraval at 25-50 m depth in March 1997 (Figs 1-4). The morphometric measurements of the specimens are listed in Table 1. A sucker fish Remora sp. was found attached in the gill cavity (Fig. 3).

The authors are thankful to the survey staff Ms. Y.D. Savaria, J.D. Vanvi and J.P. Polara and the field assistants for assisting in the course of the work.

Reported by B. Manoj Kumar, Joe, K. Kozhakudan, Sujitha Thomas and A.P. Dineshbabu, Veraval Research Centre of C.M.F.R.I., Veraval - 362 269, India.

878 On the catch of a giant octpus from Gulf of Mannar off Rameswaram

The Giant octopus, *(Octopus dofleini)* is caught rarely from the Indian seas. It is otherwise endemic along North Pacific, northern California and Alaska to Japan coasts. The catch of a similar giant octopus at Rameswaram on January 17, 1997 was reported by Lipton and Jayabalan (in Press).

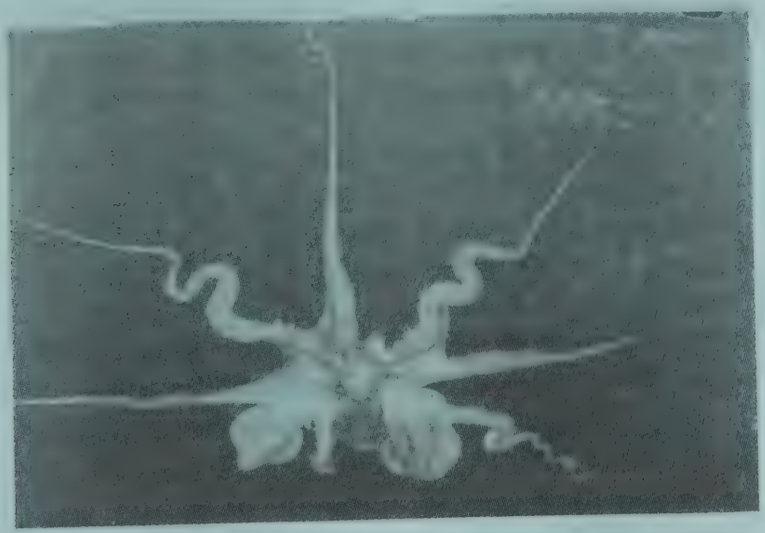

Fig. 1. The giant octopus caught from Gulf of Manner.

On 23rd December, 1997, the fishermen from Mukundarayarchatram while operating the bottom set gillnet caught the present female giant octopus off the coast of Dhanushkodi point in Gulf of Mannar at 18 m depth. The total length of the animal was 150 cm and the dorsal mantle length was 52 cm. The length of the characteristic short arm (4th arm) was 60cm while the lengths of other five arms were 98 cm each. The first and second arms appeared to have been cut by predators. The specimen weighted 19 kg.

The octopus was taken in acution by a private company for Rs.5,700/- (Rs.300/kg) and was exported.

Reported by : A.C.C. Victor and K. Jayabalan, Mandapam Regional Centre of CMFRI, Mandapam camp - 623 520.

879 On a whale shark at landed Pamban

A male whale shark *Rhincodon typus* Smith measuring a total length of 9.2 m was landed at Pamban on 17-4-'98 (Fig.1). The fish weighing approximately 1.5 t was caught by a bottom-set gill net unti locally called *Paru valai* operated off Pamban in the Gulf of Manmar at a depth of 30 m. The fish was buried after removing liver and fins as there was no demand for flesh.

Reported by V. Sethuraman, Mandapam Regional Centre of CMFRI, Mandapam Camp - 623 520.

880 On the occurrence of bicolour parrotfish, off Kakinada

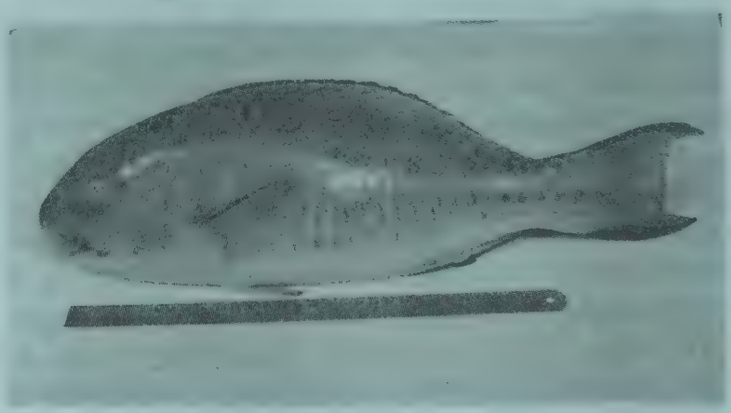

Fig. 1. Bicolour parrotfish, *Cetoscarus bicolor* caught off Kakinada.

A single specimen of *Cetoscarus bicolor* (Ruppell) commonly called bicolour parrotfish belonging to family Scarida was observed in the trawler catches landed at Kakinada Fisheries Harbour on 16-3-'98. The fish measuring 48.8 cm was caught by a trawler unit operated off Kakinada at a depth of 35 m (Fig. 1). This species is distributed in the eastern Indian ocean close to regions of deep water on coral reefs and hence the capture of the fishes outside this habitat is not common.

Since the occurrence of this species is reported for the first time along the Kakinada coast, few morphometric measurements recorded on the specimen in mm are given below :

Total length	-	488
Standard length	-	387
Head length	-	122
Snout to pectoral base	-	106
Pectoral fin lengt	-	75
Dorswal fin length	-	209
Pelvic fin length	-	64
Anal fin length	-	85

Fin ray counts : Dorsal : X+10, Anal : 11+9, Pectoral : 1+13, Pelvic : 1+5

Reported by N. Burayya, Kakinada Research Centre of CMFRI, Kakinada - 533 004. □

881 BOOK REVIEW

Title	:	**A Field Guide to the Seashores of Eastern Africa and the Western Indian Ocean Islands**
Editor	:	**Mathew, D. Richmond**
Publisher	:	**The Swedish International Development Co-operation Agency (SIDA)**
Price	:	**Ł 20; $ 32**
ISBN	:	**91-630-4594-X**
Year of publication	:	**1997**
No. of pages	:	**448**
Size	:	**165 x 242 mm**
Binding	:	**Paperback**

Since the UNCED declaration on "protection of the oceans and all kinds of seas, including enclosed and semi enclosed seas and coastal areas and protection, rational use and development of their living resources", there has been a growing awareness the world over to organise environmental conservation programme, to preserve the coastal biodiversity and the habitats, to encourage the development that minimise negative impacts on coastal live support systems. As the zone is of immense importance and diverse economic use to man, the marine nations realised the priorities and as such developed many management plans. The book under review "**A guide to the Seashores of Eastern Africa and the Western Indian Ocean Islands**" edited by **Matthew, D. Richmond** is first step to achieve the priortities in ICZM plan. It is an excellent compilation of all sea shore/coastal related patterns, processes and biological diversities in the tropical waters of Eastern Africa and Oceanic Islands presented through 448 papers, 154 colour plates and 8 colour maps. This book is the result of 6 years preparation and contribution of 48 authors from 14 countries. The complexity involved in the subject matter and their editing is admirable.

Although the central theme of the book is the taxonomic description of species occurring in the seashores and coastal habitats, the introduction spread over 39 pages provides valuable information on the problems, prospects and developmental needs in the seashore for future generations. This introduction itself is the contributions of 9 authors and very briefly touches diverse aspects. Here the editor has carefully integrated all relevant geological, physical, chemical and biological processes that have taken place in the shore habitats like mangroves, sea grass beds, rocky shores and cliffs, lagoons, coral reefs, biodiversity and ecological interactions, the people and their historical, social and economic background, livelihood activities like mangrove harvest, coral mining, coir rope manufacture, salt production, fishing, acqaculture of sea weeds, bathsponage, crustaceans molluscs and fishes; the traditional

fishing crafts and gear in the area; coastal related commercial activities like marine curios trade, live reef animals trade and coastal tourism. The loss of coastal habitats and biodiversity as a consequence of urban seawage and garbage, industrial discharges, oil pollution and the ultimate impact on environment and the socio-economics in the regions is also presented briefly in the introduction. The coastal erosion sedimentation caused by nature and trawling related formation of plumes of suspended benthic sediments and their effects on the somethering on corals and seagrass meadows are also given in this section. The authors rightly proposed ICZM plans for each maritime state in the region. The status, scope and potentials of bioprospecting in marine habitats for searching, locating and identifying candidate species, which produce a range of compounds of biomedical and therapeutic value as drugs is summarised in this general introduction, and the author proposes strategies for conservation and sustainable harvest of such valuable biota and also emphasised the impending need for pure taxonomic research. The role of FAD's and AR's in enhancing coastal production is briefly given and recommended them as a popular marine management tool for a long term economic gain from the coastal sector. The coastal dangers and treatments given in this section narrate various environmental dangers, harmful coastal insects, dangerous food and the multiple dangers in the water and proposes preventive measures as well as treatments required in each case. The introduction is concluded with a note on the use of remote sensing of coastal habitats in resource management and planning.

This guide describes about 1,600 species of plants and animals commonly encountered along the shores, in beaches, in mangrove forests, in lagoons, on mud flats, in seagrass beds, in coral reefs and in the shallow coastal habitats of Somalia, Kenya, Tanzania, Mozambique and S. Africa and Western Indian Ocean Indian Ocean Islands like Comoros, Madagascar, Zanzibar, Reunion, Mauritius and Seychelles. The taxonomic description of common species belonging to plants, coastal lichens, marine macro algae, Cyanophyta, phytoplankton and zooplankton (under several phyla), meiofauna, Porifera, Cnidaria, Platihelminthes, Nemertenea, Echiura and Sipunculs, Annelida, Chelicera, Unirama, Crustacea, Mollusca, Echinodermata, miscellaneous phyla Ascidiacea, Pisces, Reptilia, Aves and Mammalia form the bulk of this book. The species description includes the most salient identifiable characteristics, habitat, distribution and the family to which the species belongs. The species are arranged in the phylogenetic order from phylum, class, order to family. The species description together with watercolour illustrations given in this book would facilitate students, naturalists and tourists to identify the species in the field itself. Quite interestingly 15 % of this biodiversity is reported from Western Indian Ocean, and about 35 % of them are common to the Indo-Pacific region. The taxonomy is written by specalists in respective fields and followed uptodate nomenclature. This guide presentes the rich and diverse seashore and coastal sea biodiversity and the pressing problems that threatens the various habitats and the species. It also provides suggestion for the prevention of further degradation and conservation measures required in the coastal zone.

The appendix provided at the end of this book is an excellent treasure of information on general glossary; useful words in relevant languages; prefixes and suffixes; key to caridean shrimps, sponges, Echiuira and Sipuncula; basic steps in surveys and sampling; lunar calender; units of measurements; abbreviations; marine under coastal related organizations; coastal and marine protected areas; code of practice for visitors and bibliography of more than 1000 references related to all aspects are dealt with in the book.

This guide although pertains to the sea shore and coastal biota of Eastern Africa and Western Indian Ocean Islands, is relevant and useful to marine biology/fisheries students of India and other tropical countries, as the flora and fauna are almost common in the regions. As beach, coastal and island tourism is gaining greater importance as a fast growing industry in many maritime nations, field guides of this nature would promote tourism while the same encourages the ecotourists to protect and conserve he habitats and their biota. The trolpical coasts of

India and surrounding oceanic islands with the diverse habitats and rich and varied biotic composition offer scope for similar field guides from our country as a measure to create awareness on the resources and to attract ecotourists. This book under review is a collection of appropriate and authentic record of information and is recommended as a reference text for postgraduates, collage/university libararis and as a guide to ecotourists and environments.

Dr. N.G. Menon, CMFRI, Cochin - 682 014

882 On the occurrence of the gastropod parasite *Prostilifer* sp. on the holothurian *Holothuria scabra* Jaeger at Tuticorin

Echinoderms, being sluggish animals are subjected to the attack of a host of fouling and parasitic organisms. They ward off these attempts to a large extent by means of the toxins present in the body wall. When the bodies are rigid as in the case of asteroids and echinoids, they have pedicellariae which act as pincers to remove undesirable organisms from the surface of the body. Despite these mechanisms, parasites do occur on echinoderms.

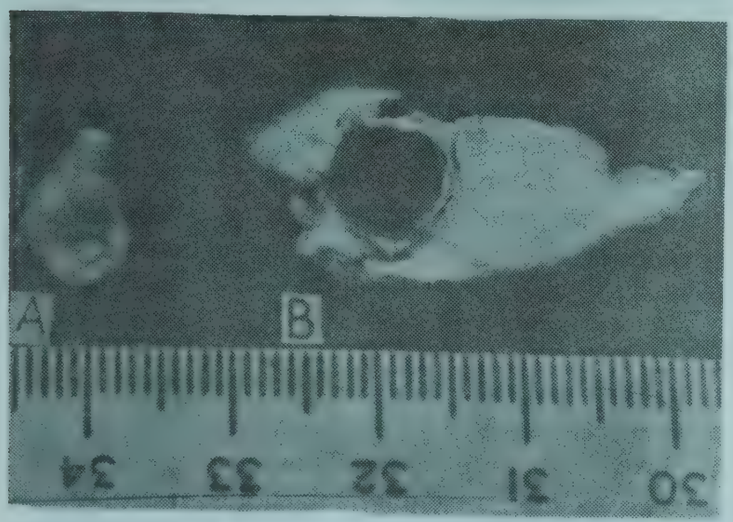

Fig.1. A. Entire parasite, B. Section of the skin showing the cavity where the parasite was lodged.

While collecting brood stock material for hatchrey purpose, sometimes the sea cucumber *Holothuria scabra* with gall formation was noticed. When a bodywall of such specimen is cut open, a gastropod of the genus *Prostilifer* was found deeply embeded in the skin. The presence of the gastropod parasite was indicated by the apex of the shell, which slightly projected out. When touched, it withdrew into the gall. Though thousands of *H. scabra* were examined during the last 35 years, only a few instances of such galls were noticed. Normally, the skin of *H. scabra* is 5-10 mm in thickness. As a result of gall formation, the skin becomes extra thick.

*** Reported by D.B. James, Tuticorin Research Centre of CMFRI, Tuticorin - 628 001, India.**

883 On a large sunfish landed near Mandapam

A sunfish, *Ranzania laevis* (Pennant) measuring 660 mm total length was caught on 5.3.1998 in shore-seine near Mandapam in Palk Bay. In fresh condition its colour was bluish with dark above and pale white below with small hexagonal plates and smooth skin. Six streaks of lighter colour bordered with dark descended from snout to gill slits and curved downwards to the ventral profile. The posterior three streaks were branched with dark spots. The lips were produced forward beyond the teeth closing as a vertical slit.

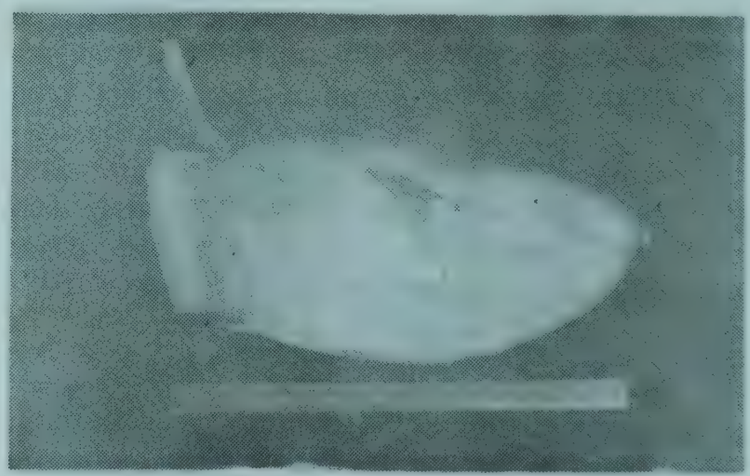

Fig. 1. The sun fish *Ranzania laevis*.

The specimen was a female weighing 8.2 kg. It was preserved and kept in the museum of the Mandapam Regional Centre of CMFRI. Detailed morphometric measurements (in mm) of the sunfish are given below.

Total length	660
Depth of body	330
Head length	240

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Length of dorsal fin	170	Caudal fin length	65
Length of ventral fin	105	Length of mouth opening (slit)	45
Snout to pectoral fin	250	Snout length	100
Snout to dorsal fin	560	Diameter of eye	35
Snout to pelvic fin origin	510	Weight	8.2 kg
Snout to anal opening	400	Sex	Female
Base of pectoral fin	40		
Base of pelvic fin	58		
Height of body at caudal fin region	240		

Reported by A.C.C. Victor, D. Kandasami and N. Ramamoorthy, Mandapam Regional Centre of CMFRI, Mandapam Camp - 623 520, India.

872 समुद्री शैवाल से प्राप्त उत्पाद, संसाधन और उपयोग

पी. कलाधरन, एन. कालियपेरुमाल और जे. आर. रामलिंगम

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प्रस्तावना

समुद्री माक्रोएल्गे अथवा समुद्री शैवाल थल्लोफाइटा नाम के अपुष्पी पौधों के वर्ग के है । ये स्वपोषित पौधे है और समुद्र में अंतराज्वारीय और उपज्वारीय क्षेत्रों में बढते हैं । चट्टानी या प्रवाल प्रतलों में इसकी अच्छी बढती होती है । दक्षिण और दक्षिणपूर्व एशियाई देशों में शताब्धियों से विभिन्न प्रकारों के शैवालों का उपभोग हो रहा है । खाद्य, रसायन और औषध निर्माण केलिए उपयोग किये जानेवाले *कोलोइड्स* जैसे *ऐगर, एल्जिन* और कैराग्नीन का निर्माण समुद्री शैवालों से किया जाता है । समुद्री शैवाल प्रोटीन, वैटमिन्स, खनिज और सूक्ष्म मात्रिक तत्वों से समृद्ध है । भारत में करीब 720 समुद्री शैवाल जाति उपलब्ध है, जिनमें 60 वाणिज्यिक दृष्टि से अत्यधिक महत्वपूर्ण है और ये तमिलनाडु, गुजरात, लक्षद्वीप और आन्डमान निकोबार द्वीपों में प्रचुरमात्रा में उपलब्ध होते हैं ।

फाइको-कॉलोइड के निर्माण केलिए आवश्यक समुद्री शैवाल उत्पादन का 40% विकासी देशों से होता है । 50% समुद्री शैवाल ऐगर उत्पादन केलिए, 32% कैरागीन उत्पादन केलिए और 18% अल्गिनेट उत्पादन केलिए उपयोग किया जाता है । समुद्री शैवालों का अधिकतर योगदान विकासी देशों से होने पर भी फाइको-कॉलोइड निर्माण उद्योग डेनमार्क, फ्रांस, जापान, नोरवे, स्पेन, यूके और यू एस ए आदि विकसित देशों परं ही केन्द्रित है, जिसका मुख्य कारण निचोडन और शुद्धीकरण से संबंधित प्रौद्यगियों पर इन देशों द्वारा बर्तनेवाली गुप्तता है ।

भारत में *ऐगर* और *अल्गिनेट* निर्माण करनेवाले 60 से अधिक उद्योग हैं और आजकल कई उभर आ रहे है। आज समुद्री शैवालों का उपयोग ऐगर और अल्गिनेट के निर्माण केलिए ही होता है । खाद्य के रूप में इसका उपयोग बहुत कम है । समुद्री शैवाल जैसे *ग्रासिलेरिया इड्युलिस, जेलीडियेल्ला एकेरोसा, ग्रासिलेरिया क्रास्सा* और *जी. फोलिफेरा* का विदोहन ऐगर निर्माण केलिए और *सरगासम* और *टरबिनेरिया* की जाति का विदोहन *ऐल्जिन* निचोडने केलिए होता है । अज्ञान के कारण लगभग 70% खाद्य योग्य और अन्य समुद्री शैवाल अविदोहित रहते है। यह लेख समुद्री शैवालों के विभिन्न उपयोगों पर प्रकाश डालने केलिए तैयार किया गया है ।

फाइको कॉलोइड्स के रूप में समुद्री शैवाल

1. ऐगर

ऐगर कुछ लाल शैवालों के कोश भित्ति के मुख्य संघटक है । ऐगार-ऐगार *यूकीमा* नामक शैवाल से निकाले जानेवाले एक जेली केलिए प्रयुक्त मलय शब्द है, जिसे अब *कैराग्नीनन* कहते है । 'ऐगर' शब्द का प्रयोग आज उस *शैवाल* गैलेक्टेन्स केलिए होता है जिसमें ऐगेरोस होता है ।

श्रोत: ऐगर उत्पादन के कच्चे माल हैं *जेलीडियेल्ला*

ऐकेरोसा, ग्रासिलेरिया इडुलिस, जी. वेरुकोसा जैसे लाल शैवाल और *जेलीडियम*, टीरोक्लाडिया और *एनफेलीशिया* जाति के शैवालें ।

निचोडने की रीति

सूखे कच्चे मालों को शुद्ध करके ताज़े जल में डुबोकर आतपित करते है । शैवालें विरंजित होने तक यह प्रक्रिया जारी करती है । इसके बाद 3 से 4 घंटों तक समुद्री शैवाल को उबालते है । उबाले गये गाढ़ा द्रव पदार्थ को दाब निस्यंदक (फिल्टर प्रेस) के ज़रिये निस्यंदित करते है । यह निस्यंद (फिलटरेट) सामान्य ताप में जेली बन जाता है । ऐसे ऊर्णित जेली को बार बार प्रशीतित करने और गलाने से जेली और भी शुद्ध हो जाता है । इसे फिर आतपित करके ऐगर स्ट्रिप लेते है । इन ऐगर स्ट्रिपों को चूर्णित करके विपणन किया जा सकता है । उबालने के पहले सोडियम हाड्रोक्साइड से एलक्लाइन ट्रीटमेन्ट करने से बढती मुनाफा होगी ।

उपयोग :

पनीर बनाने और सालाड संसाधन में जेलिंग और प्रगाढक के रूप में ऐगर का उपयोग किया जाता है । मछली और मांस के डिब्बाबंद उत्पादों के संसाधन में धातुनिर्मित डिब्बा के रक्षी कवच के रूप में और परिवहन के दौरान कंपन से बचाने केलिए भी इसका उपयोग किया जाता है ।

सुराओं में स्वच्छन कर्मक के रूप में, औषध निर्माण में दीर्घकाली कोष्ठबद्धता केलिए लैक्सेटिव के रूप में और बैक्टीरियल और कवकी संवर्धों के आधार के रूप में इसका उपयोग किया जाता है । ऐगर एक आयन विनियमक है और आयन विनिमय रेसिन उद्योग में इसका उपयोग किया जाता है । चर्म लेप और मरहम के संघटक के रूप में भी इसका उपयोग होता है । कागज़ और कपडे उद्योगों में भी ऐगर का उपयोग किया जाता है ।

2. ऐल्जिनिक अम्ल

ऐल्जिन या ऐल्जिनिक अम्ल सभी ऐल्जिनेटों का प्रमुख संघटक और एक अच्छा झिल्ली श्लैष्मक है । ऐल्जिनिक अम्ल के विभिन्न लवणों को 'ऐल्जिनेट' कहते है । सभी ऐल्जिनिक अम्लों केलिए 'ऐल्जिनेट' शब्द का प्रयोग करता है और यह सोडियम ऐल्जिनेट का व्यापारिक नाम भी है । ऐल्जिनिक अम्ल और इसके लवण द्विसंयोजक और त्रिसंयोजक धातु अयन के साथ जल में अविलेय है, जबकि क्षार धातु लवण जल में विलेय होते है ।

श्रोत:

शीतोष्ण क्षेत्र से प्राप्त भूरा समुद्री शैवाल जाति *एक्लोनिया, माक्रोसिस्टिस, अन्डेरिया, लामिनेरिया* और *डरविल्लिया* से और उष्णकटिबंधी क्षेत्र से मिलनेवाले *टरबिनेरिया सरगासम, साइटोसिरिया* और *हामोफाइसा* से एल्जिनिक अम्ल तैयार किया जाता है ।

निचोड

भूरे समुद्री शैवालों से एल्जिनिक अम्ल या सोडियम एल्जिनेट अलग करने केलिए तनु सोडियम कारबनेट लायनी जोडता है ।

10 ग्रा समुद्री शैवाल को छोटे छोटे टुकडों में काट करके गरम आसूत जल (60°C, 300 मि लि) में 2 घंटों तक डालते है । इसके बाद गरम जल से निस्तारण के जरिए समुद्री शैवाल अलग करते है । समांगीकरण (होमोजेनेसेशन) के बाद समुद्री शैवालों को 200 मि लि सोडियम कारबनेट जोडकर 2 घंटों तक गरम करते है। इसके बाद 500 मि लि पानी जोडकर अच्छी तरह मिश्रित करते है । इस गरम लायनी निस्यंदित करके 10% एच सी एल (P^H 1.0) अम्ल जोडने से एक जिलेटिनीकृत अवक्षेपण मिलता है । इस जेल में 2.50% मेथनेल के 500 मि ली जोडते है और मिश्रण को 10% NaOH जोडकर उदासीन करते है । एक रात इसी प्रकार रखकर इस मिश्रण का निस्यंदन करके उदासीन जेल अलग करते है । इसप्रकार प्राप्त जेल को क्रमशः 60% और 95% ऐलकोहोल या एसेटोन से साफ करते है और 40°C में 12 घंटों तक सुखाते है । कैलशियम एल्जिनेट और सोडियम एल्जिनेट के बाँछित pH मिलने केलिए कैलशियम और सोडियम के कारबनेट लवण जोडते है ।

उद्योगों में एक टुकडे के केल्प (ताज़े या सूखे) के साथ 0.8-1% कैलशियम क्लोराइडु लायनी जोडते है और लामिनारन, मानिट्रोल और अन्य लवणों को दूर करने केलिए मृदु जल से साफ करते है । इसके बाद 5% हाइड्रजन क्लोराइड जोडकर अधिकतम मृदु जल से साफ करके 4% सोडियम कारबनेट लायनी जोडते है । 4 घंटों तक 40-50°C में निक्षालन जारी करता है और साथ साथ पैस्ट बनने तक केल्प को मसृण करते है ।

इस पैस्ट में 3:7 की दर में पानी जोडकर हल्का करके प्रखर वातायन करते है । इसके बाद इस द्रव को एक सेन्ट्रिफ्यूज से बहुत तेज़ बहाकर एक क्लारिफाइंग टैक्टा में संग्रहित करता है । 6-10 घटों के बाद सेल्लुलोस पदार्थ एकत्र होकर एक प्लवमान केक बन जाता है और द्रव अपवाह किया जाता है । इस रंगीन द्रव को हाइड्रेटड अलूमिना, जेलेटिनस सिलिका और अलूमिनियम एल्जिनेट से तैयार किये गये अधिशोषी झिल्लि जोडकर रंगहीन बानाते है । सेन्ट्रिफ्रयूगेशन के ज़रिए झिल्ली अलग करती है । इस साफ द्रव को एक मिश्रण बाधिका से बहलाती है जहाँ यह द्रव सशक्त हाड्ड्रोजन क्लोराइड से मिलता है और अवक्षेप टैंक में जाता है । लायनी का pH 1.5-2.0 में स्थिर रखता है । इस प्रकार अवक्षेपित ऐल्जिनिक उम्ल को बास्केटों में डालकर जल निकास करते है और एल्कोहोल से साफ करके सुखाते है ।

उपयोग :

औषध निर्माण उद्योग में. पायसीकारक के रूप में, टिकियाओं में पूरक के रूप में, मरहमों में आधार के रूप में ऐल्जिनिक अम्लों का उपयोग किया जाता है ।

रुधिर रोधी प्लास्टर, स्लिमिंग एजेन्ट, सूक्ष्मजीवी फिल्टरों में इसका उपयोग होता है ।

प्रसाधन सा अपमार्जक और साबुन निर्माण उद्योगों में ऐल्जिनिक अम्ल का उपयोग किया जाता है ।

खाद्य प्रौद्योगिकी में एल्जिनेटों का महत्वपूर्ण स्थान है । सुरा, बेकरी मिठाई आदि के निर्माण में इसका उपयोग किया जाता है । मछली मांस और पोल्ट्री/उत्पादों के अति हिमयीकरण (डीप-फ्रीजिंग) केलिए भी ऐल्जिनिकी जेल का उपयोग किया जाता है ।

सेरामिक और लेथर उद्योगों में भी ऐल्जिनेटों का प्रयोग किया जाता है । वस्त्र उद्योग में प्रिन्टिंग और पेइन्टिंग के काम में ऐल्जिनेटों का उपयोग किया जाता है ।

3. कैराग्नीन

कैराग्नीन एक सल्फेट्ड गैलाक्टन पॉलिमर है जो *गैगारटिनेशिये सोलियेरिसिये*, और हाइपनीसिंग कुटुम्ब के लाल समुद्री शैवालों से लिया जाता है ।

कैराग्नीन, ऐगर से इसलिए भिन्न है कि इसमें उच्च सल्फेट्ड फ्राक्शन और उच्च भस्म अंश है ।

श्रोत :

कोन्ड्स क्रिस्पस, गैगारटीना स्टेल्लेटा, इरीडिया जाति, *यूकीमा अलवरेज़ी, काप्पाफाइकस* जाति और *हाइपनीसिए* जाती से कैराग्नीन प्राप्त होता है ।

निचोड : 10 ग्रा समुद्री शैवाल को कुचलकर 4 घंटों तक 90°C में 750 मि लि जल और 2 ग्रा CaO मिलाकर पकाते है । इस गरम निचोड को 8000 आर पी एम में 5 मिनट केलिए सेन्ट्रिफ्यूज करते है । अधिप्लवी द्रव एकत्र करते है । निचोड के pH को 8-8.5 के बीच रखकर मृदु क्षार लायनी जोडती है । क्षार अधिप्लवी के साथ एथनॉल या आइसोप्रापाइल एल्काहॉल जोडते है । 5 से 8 मिनट केलिए 5000 आर पी एम पर निस्यंदन या सेन्ट्रिफ्यूगेशन के जरिए कोयागुला माने जमाव का संग्रहण करते है और 50-60°C में सुखाते है । सूखे कोयागुला पीसने पर कैराग्नीन चूर्ण प्राप्त होता है ।

उपयोग :

खाद्य उद्योग में विविध प्रकार के सिरप, क्रीम, चीस आदि की तैयारी में इसका उपयोग किया जाता है । बियर, ज्यूस और सुराओं में स्वच्छनकारी के रूप में भी इसका उपयोग किया जाता है ।

औषध निर्माण उद्योग में पायसीकारक के रूप में और गुटिका, सिरपों आदि के बन्धन कारक के रूप में इसका उपयोग किया जाता है । अलसेर थेरापी और ब्लेड वेसल्स के रोगों के लिए भी इसका अधिकतर उपयोग

किया जाता है । टूथ पेस्ट, त्वचा मरहम आदि में भी इसका उपयोग किया जाता है । वस्त्र उद्योग में डिसाइन, प्रिन्टिंग्र, डाइ आदि कार्यो में इसका उपयोग किया जाता है ।

खाद्य के रूप में समुद्री शैवाल

समुद्री शैवाल प्रोटिन, वैटमिन्स, अमिनोएसिड्स, ग्रोथ होर्मोन्स, और मिनेरल से संपुष्ट है । अयोडिन संपुष्ट *आस्परागोप्सिस, टाक्सिफेरमा, सोरकोनिमका* समुद्री शैवालों से हाइपोथैरोडिस (गोइट्र) रोग का नियन्त्रण करते है । जापान में *नोरी,* कोंबु और *वाक्मे* नामों में वर्ष में 1,00,000 टन समुद्री शैवाल खाया जाता है ।

1. नोरी :

पोरफाइरा से संसाधन के बाद प्राप्त विभिन्न खाध उत्पादों को *नोरी कहते है । सूप, सॉस और ब्रोथ में सुरुचि कर्मक के रूप में इसका उपयोग किया जाता है।*

2. कोम्बु

कोम्बु लामिनोरिया से तैयार किया जाता है । सूपस्टोक, उबाले तरकारी स्नाक या डिश में इसका उपयोग किया जाता है ।

3. वाक्मे

भूरा समुद्री शैवाल *अन्डेरिया पिन्नाटिफिश* से इसकी तैयारी की जाती है ।

4. सैलेड

सैलेड की तैयारी केलिए *कॉलेरपा रेय्समोस, कॉलेरपा सेरटुलारियोड्स, कॉडियम जाति, ग्रासिलेरिया कनफेरवेईड्स, ग्रासिलेरिया यूकिमोइड्स, हाइड्रोक्लाथरस क्लाथ्रटिस, लॉरेनशिया पापिलोस* और *पोरफाइरा* जाति के शैवालों का उपयोग किया जाता है ।

समुद्री शैवाल *उलवा लाक्टुका* से समुद्री शैवाल मसाला और जाम और *ग्रासिलेरिया इडुलिया* से पिकिल, वेफर, पोरिड्ज, जेल्ली आदि तैयार किया जा सकता है जिसके नुस्खा संस्थान में उपलब्ध है ।

औषध और रसायनिकों के रूप में समुद्री शैवाल

टेरपीन्स, ऐलकोइड्स, फाट्टी अम्ल और नाइट्रोजेनस कोंपाउन्डों के 6000 से अधिक सेकन्डरी मेटाबोलाइट्स समुद्री शैवाल से वियुक्त किया गया है । इनमें कइ चिकित्सा के क्षेत्र में अत्यधिक महत्वपूर्ण माना जाता है ।

मानिटोल

भूरे शैवाल में दिखाये पडनेवाला यह एक महत्वपूर्ण शर्करा ऐल्काहॉल है ।

श्रोत :

फ्यूकस विसिकुलस, लामिनेरिया हाइपेरबोरिया, इक्लोनिया रेडियाटा, बाइफरकारिया ब्रास्सिफोरमिस, सरगासम जाति *टरबिनेरिया* जाति आदि से मानिटोल लिया जाता है।

उपयोग :

गुटिकाओं के निर्माण में मानिटोल का उपयोग किया जाता है । डयाबेटिक खाद्य और चूयिंगगम बनाने केलिए भी इसका उपयोग किया जाता है । पेन्ट और वार्निश उद्योग, लेथर और पेपर उद्योग में धूलन चूर्ण के रूप में इसका उपयोग किया जाता है । विस्फोटकों के निर्माण में भी इसका उपयोग किया जाता है । प्लास्टिक उत्पादन में रेसिनों के उत्पादन केलिए प्लास्टिसाइजेर्स के रूप में मानिटोल का उपयोग किया जाता है ।

उर्वरक के रूप में समुद्री शैवाल

समुद्री शैवालों में माक्रों और माक्रों न्यूटियेन्ट्रस से अतिरिक्त ऑक्सिन्स, साइटोकिनिन्स आदि होर्मोन्स जो पेड पौधों की बढती केलिए सहायक है, निहित है । इसलिए उर्वरक के रूप में इसका .उपयोग किया जाता है । गोबर के साथ समुद्री शैवाल कम्पोस्ट बैंगन, टैपियोका आदि की बढती केलिए अच्छा उर्वरक है । आज द्रव के रूप में भी (लिक्विड समुद्री शैवाल फेरटिलाइज़र) यह बाज़ारों में उपलब्ध है ।

उर्वरक के रूप में समुद्री शैवाल

समुद्री शैवालों में माक्रों और माक्रों न्यूटियेन्ट्रस से अतिरिक्त ऑक्सिन्स, साइटोकिनिन्स आदि होर्मोन्स जो पेड पौधों की बढती केलिए सहायक है, निहित है । इसलिए उर्वरक के रूप में इसका उपयोग किया जाता है । गोबर के साथ समुद्री शैवाल कम्पोस्ट बैंगन, टैपियोका आदि की बढती केलिए अच्छा उर्वरक है । आज द्रव के रूप

में भी (लिक्विड समुद्री शैवाल फेरटिलाइज़र) यह बाज़ारों में उपलब्ध है ।

जन्तु खाद्य के रूप में समुद्री शैवाल

ऐगर निकालने केलिए उबाले गये निचोड का निस्यंदन करने पर प्राप्त पदार्थ में कोलोइड्स, कारबोहाइड्रेट्स, प्रोटिन, वैटमिन्स और मिनेरेल्स की अच्छी मात्रा होती है । इसका कुकुट फार्म, मछली फार्म, आदि में जन्तु खाद्य के रूप में उपयोग किया जा सकता है।

873 भारत की सर्पमीन मात्स्यिकी

एन. जी. मेनोन, के. बालचन्द्रन और के. एम. स्करिया

केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान, कोचिन 682 014, भारत

आमुख

भारत के उत्तर-पश्चिम और उत्तर-पूर्व तटों के परंपरागत मत्स्यन तलों से सर्पमीनों की विपणन योग्य जाति पकडी जाती है और ये अधिकतः उप-पकड के रूप में प्राप्त होती है । यूनान, रोम, जर्मनी, जापान और कई एशियाई और यूरोपियन लोगों के सर्पमीन मन पंसद खाद्य है जब कि भारत में यह गरीबों का खाद्य है । लेकिन उनकी निर्यात माँग उपलब्ध तलों से इसे विदोहन करने के अतिरिक्त इसके पालन और जीवित अवस्था में परिवहन करने केलिए भी प्रेरणा देती है ।

सर्पमीन लंबी और साँप की जैसी होती है । ये तल छट में बिलों में रहते है । लेकिन कुछ खुले समुद्र के वेलापवर्ती क्षेत्रों में भी जाते है । अच्छे तैराक होने पर भी अधिकतर सर्पमीन स्थानबद्ध रहते है और ये अच्छे घ्राण शक्ति के होते है । ये मुख्यतया कवच प्राणि और छोटी मछलियों को खाते है और इनके दाँत इसकेलिए अनुकूल भी है । अधिकतर सर्पमीन उष्णजलीय निवासी होते है और प्रवाल भित्तियों में प्रचुर मात्रा में दिखाये पडते है । अलवणजलीय जाति सहित सभी सर्पमीन खुले समुद्र में प्रजनन करते है और जीवन का प्रारंभ काल वेलापवर्ती क्षेत्र में बिताते है । इनके डिम्भक देखने में प्रौढों से भिन्न होते है । डिम्भक प्रौढ होने के पहले एलवर बन जाते है । ये अरब समुद्र में 1000 मी गहराई के क्षेत्र में प्रचुर मात्रा में उपलब्ध है । भारतीय समुद्रों से इसकी छः कुटुम्बों की 18 जातियों की उपस्थिति रिपोर्ट की गई हैं ।

स्थानीय नाम

गुजरात और महाराष्ट्र में सर्पमीन 'वाम' नाम से जाना जाता है । तमिलनाडु में इसे *बिलंगु, कुलिवि पाम्बु* या *कडल* पाम्बु; आन्ध्रप्रदेश में *नल्लापाम्बु, टालबॉन, टेल्लापामु, पासुपु पामु;* उडीसा में *दान्तिया सापु, लहनटारा, पान्टिसापा शता हाली* और पश्चिम बंगाल में *समूद्बेरा बेरुआ, बाम* और *सोना बाम* नाम से जाना जाता है।

संक्षिप्त जैविकी और पारिस्थितिकी

1. ऐंगुल्लिडे अलवणीय जल के सर्पमीन

ये रात में अपना खाद्य ढूँढते है और तलीय अकशेरुकियों को खाते है । खुले समुद्र में प्रजनन करते है और इसके डिम्भबकों को (लेप्टोसेफालाइ) प्रवाह तट की ओर ले जाते है, वहाँ ये एलवर अवस्था प्राप्त करके नदियों में जाते है । *ऐंगुल्ला बंगालेनासिस बंगालेनसिस* 120 से मी तक बढते है और *ऐगुल्ला बाइकोलर बाइकोलर* 80 से मी तक बढते है। ये दोनों भारत की ऐंगुल्लिडे जाति के है ।

2. कोनग्रिडेः कोनगर सर्पमीन

भारत में उपलब्ध इसकी एकमात्र जाति है *यूरोकोनगर लेप्टूरस* जो 40 से मी तक बढती है ।

3. मुरेइनसोइडेः पैक कोनगेर्स

पैक कोनगेर्स को तटीय उष्णकटिबंधीय जल क्षेत्र से गभीर समुद्र के मृदु तल में 100 मी की गहराई तक पाये जाते है । उथला जल की जाति रात्रिचर मछलियाँ है और ये तलीय मछली और कवचप्राणियों को खाते हैं। गुजरात और महाराष्ट्र में मानसून महीनों में *सी. टालाबोनोईड्स* और *एम. सिनोरियस* पाये जाते हैं । भारत में रिकार्ड की गयी चार जाति और उनकी अधिकतम लंबाई इस प्रकार है । *कोनगेरसोक्स टालाबोन* 80 से मी *सी. टालाबोनोइड्स* 250 से मी, *मुरेनिसोक्स बगिया* और *एम 180 से मी सिनेरियस* 80 से मी ।

4. मेरेनिडेमोरिइस:

400 से मी तक बढने वाला सबसे बडा सर्पमीन *थसौडिए माक्रुरा* इसी कुटुम्ब का है । ये अधिकतः उष्णकटिबंधीय क्षेत्रों के उथला जल में रहते हैं । शैल -भित्त और चट्टानी क्षेत्रों में इनको प्रचुर मात्रा में पाये जाते हैं । ये रात में सक्रिय होते है और शैल भित्तीयों में देखे जानेवाले जीवियों, विशेषतः कवचप्राणियों को खाते है ।

रिकार्ड की गयी जाति और उनके अधिकतम आयाम इस प्रकार है । *थसौडिए माक्रूरा* 4000 से मी, *एकिड्ना नेबुलोसा* 80 से मी, ई *ज़ीब्रा* 150 से मी, *लाइकोडोन्टिस मेलेगारिस* 120 से मी और *सिडीरिया पिक्टा*-140 से मी।

5. ओफिकथिडेः स्नेक ईल और वेर्म ईल

इनको अधिकतः उष्णकटिबंधीय और उपोष्णकटिबंधीय जलक्षेत्र में पाये जाते है । ये अधिकतः नितलस्थ है और ज्वारनदमुख, उपतट क्षेत्र के आविल जल, लैगून अलवण जलक्षेत्र और खेतों में रहते है । ये छोटे छोटे अकशेरूकियों को खाकर जीते है ।

सीकुला टेरिजीराः

इस कुटुम्ब की चार जातियाँ हैं । *लाम्नोस्टोमा ओरियेन्टालिस* और *नीनचेलिस बिटोडिज्कि* जो 30 से मी तक बढती है और अन्य दो जाति *सोडोनोफिस बोरोक* और *पी. कानक्रिवोरस* क्रमशः 100 से मी और 75 से मी तक बढती है ।

ऑफिडिडेः कस्क ईल, ब्रोटुलास

इसकी केवल एक जाति है *ब्रोटुला मल्टिबारबाटा*। बडी मछली 650 मी तक की गहराई में रहना पसन्द करती है तो छोटी मछलियाँ वेलापवर्ती होती है और साधारणतया प्रवाल भित्तियों में दिखायी पडती है । ये 50 से मी तक बढती है ।

मात्स्यिकी की वर्तमान स्थिति

पकडः

सर्पमीन के आकलित वार्षिक पकड 1976-95 के दौरान औसत 7277 टन के साथ 4309 से 12997 टन के बीच विविध थी । आनाय बनाने पर भी हाल के वर्षे में पकड कम थी । पाँच सालों की औसत पकड यह दिखाता है कि 1976-1980 में पकड अधिक (9832 टन) थी और 1981-84 और 1985-90 में क्रमशः कम होकर 1991-95 के दौरान कुछ बढती दिखायी ।

सभी समुद्रवर्ती राज्यों में सर्पमीनों का अवतरण होता है । लेकिन इसका 82% योगदान उत्तर-पश्चिम तट (गुजरात और महाराष्ट्र) से आता है। उत्तर-पूर्व तट का (आन्ध्रा और उडीसा) योगदान केवल 13% है ।

अवतरण डाटा यह स्पष्ट करता है कि सर्पमीन का प्रतिशत योगदान गुजरात में स्थिर रहता है और महाराष्ट्र में कम हो गया है । उडीसा और आन्ध्राप्रदेश में योगदान बढ गया है ।

मत्स्यन रीतियाँ

सर्पमीनों को अधीकतः (70% पकड) ट्राल जालों से पकडे जाते है । अयंत्रीकृत संभारों से 13% पकड प्राप्त होती है । प्रत्येक तट की मत्स्यन रीति भिन्न होती है ।

मत्स्यन तल और मौसम

काम्बे, वेरावल और कच में सर्पमीन उपलब्ध है। साल भर ये मिलते है और मई-सितंबर के दौरान उच्च पकड प्राप्त होती है ।

गहराईवार वितरण :

ये 16-20 और 52-60 मी तक की गहराई रेंच अधिक पसन्द करते हैं । गुजरात-महाराष्ट्र के मत्स्यन तलों में 55-90 मी की गहराई रेंच इसकेलिए अधिक उत्पादकीय रिपोर्ट की गयी है (बापट आदि, 1982)

आर्थिक महत्व

विश्व के कई भागों में सर्पमीन महत्वपूर्ण खाद्य माना जाता है । कई एशियाई देश इसके जीवंत उत्पादों केलिए अच्छा मूल्य दते है । यूरोप में इसका विपणन पाँच रीतियों में होते है- छोटे या किशोर सर्पमीन, आंगुलिक सर्पमीन, प्रग्रहित सर्पमीन, संवर्धित सर्पमीन और ताजे एवं संसाधीत सर्पमीन । टुकडा करके, स्टीक, धूमित, आदि रूप में इसका अधिक मूल्य मिलता है । पॉलिथीन पैकों में भेजे जानेवाले टुकडों का होंकोंग में अच्छी माँग है । पॉलिथीन बैगों में ऑक्सिजन और बर्फ भर कर जीवन्त सर्पमीनों को पैक करके भी निर्यात करते है जिसका होंकोंग के बाज़ारों में अच्छी माँग है । मत्स्य चटनी और हैम बनाने केलिए सर्पमीन के मांस का उपयोग करता है । केन्द्रीय मात्स्यिकी प्रौद्योगिकी संस्थान ने धूमित सर्पमीन टुकडे और धूमित और डिब्बाबन्द सर्पमीन टुकडो केलिए

प्रौद्योगिकी विकसित की है (वेंकटरामन और कन्डोरन 1970) ।

नेथरलैन्ड और जर्मनी में धूमित एवं जेलीड सर्पमीन विशिष्ट भोज्य है तो पूरब के लोग जीवंत मछली खूब पसन्द करते है । यूरोप और पूरब देशों में 1976 के दौरान 20,000-25,000 टन सर्पमीन का उत्पाद किया था ।

छोटे आयाम के सर्पमीनों को सुरा मत्स्यन में चारा के रूप में उपयोग करता है । रंगीन बिन्दियों और रेखायेंवाले सर्पमीनों को आलंकारिक मछलियों के रूप में जलजीवशाला में रखे जाते है ।

एशिया और यूरोप में इसकी कई जाति का संवर्धन किया जाता है । भारतीय सर्पमीन *ऐंगुल्ला बाइकोलर बाइकोलर* केलिए एक समुचित प्रौद्योगिकी सी एम एफ आर आइ द्वारा विकसित की गई है । इसके अलावा जीवन्त एल्वर संग्रहण और उनके परिवहन भी (दोरैराज आदि, 1980) यहाँ किया जाता है । जापान के सर्पमीनों को विपणन योग्य आयाम तक बढाने केलिए 12 महीने लगते है और यूरोपीय देशों के सर्पमीनों केलिए 14 महीने ।

उपलब्ध संपदाओं से अधिकतम संग्रहण केलिए उचित प्रबन्धन अनिवार्य है । जीवंत अवस्था में और उपभोक्ताओं के पसन्द के अनुसार उत्पादों का निर्माण किए जायें तो निर्यात की साध्यतायें ज़रूर बढेगी ।

874 केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान की समुद्री जलजीवशाला

केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान ने विषिजम अनुसंधान केन्द्र में एक समुद्री जलजीवशाला की स्थापना की है । यह तिरुवनन्तपुरम से 15 कि मी दक्षिण और कोवलम् टूरिस्ट केन्द्र से 2 कि मी की दूरी पर स्थित है । यहाँ प्रवालों को अपनी प्राकृतिक आवास में बहुत ही सुन्दर ढंग से सजाया है । रंगीन स्पंजों, प्रवालों, शुक्तियों, चिगटों, झींगों, महाचिंगटों, कर्कटों, नक्षत्र मछलियों और समुद्री ककडियों का प्रदर्शन जो प्राकृतिक वातावरण में किया गया है बहुत ही रोचक दृश्य है।

प्रदर्शन वस्तुएं

"डोक्स्टर श्रिंप" बहुत ही सुन्दर सुरंगा चिंगट है जो प्रवालों से प्रदूषणकारियों और मलिन पदार्थों को निकालते है और प्रवाल समूहों के स्वास्थ्य बनाये रखने में सहायता प्रदान करती है । छोटे *स्पंज, समुद्री - एनमोन्स* और *समुद्री फान्स* बहुत ही रोचक दृश्य है। नक्षत्र मछली तो मछली नहीं है एकिनोडेर्म्स वर्ग के होते है । छोटे ट्यूब जैसे पैरों से इसकी मन्द चलन एक अपूर्व दृश्य है । समुद्री ककडी और जलसाही भी ऐकिनोडेर्मस है।

विविध प्रकार के द्विकपाटियों और शम्बूक को यहाँ प्रदर्शन किए गए हैं । वाणिज्यिक दृष्टि से महत्वपूर्ण झींगे, महाचिंगट और कर्कट जलजीवशाला का और एक रोचक दृश्य है ।

जलजीवशाला में उपलब्ध विभिन्न प्रकार और वर्णों के आलंकारिक मछलियाँ आकर्षण का और एक केन्द्र है।

उष्णकटिबंधीय समुद्री जलजीवशाला मछलियों में सबसे आकर्षक *एनिमोनफिश* या क्लाडन फिश समुद्री-एनिमोन्स के साथ रहते है । क्लाडन मछली उनके अतिरिक्त खाद्य एनिमोन को खिलाते है । और एक प्रकार की मछली है *सर्जन फिश* जिसके पूँछ के दोनों तरफ तेज़ छुरी जैसे काँटे है । अधिकांश जीवियों में यह लपेटकर रखे है लेकिन उत्तेजित करने पर ये छुरियाँ उठा लेते है और अपनी रक्षा केलिए उपयोग करते है । शुकमछलियों को शुकों के समान भारी चोंच होते है । प्रवाल भित्तियों से छोटी जीवियों को पकडने केलिए इस चोंच का उपयोग करते है । स्क्विरल फिश (गिलहारी मछली) और एक फीका रंग की मछली है जिसमें श्वेत धारी है और पंखें पीले है ।

ट्रिग्गर मछलियाँ आकर्षक रंग के है । बोक्स फिश, और पफ्फर फिश यहाँ उपलब्ध अन्य मछलियाँ है । पोरकूपिनेफिश भी पफ्फर के समान की मछली है ।

शलभ मछली उसके रंग और तेज़ चलन के कारण शलभों से समानता रखती है । ऐंजल फिश और एक आकर्षक मछली है । लयनश्रिंप जलजीवशला का वन्य सौन्दर्य है । इसके प्रथम पृष्ठ पख के सभी काँटें अत्यन्त तेज़ और शक्त है । समुद्री घोडा एक विचित्र प्रकार। की मछली है । इसके सिर नीचे की तरफ कुछ टेढा

और शरीर और सिर एक साथ समकोणीय दिखता है । यह अभिलम्बि स्थिति में तैरती है । इसकी लंबी परिग्राही पूँछ समुद्री शैवाल और अन्य वस्तुओं को पकडने केलिए उपयोग करता है । मादा समुद्री घोडा नर जातियों में एक थैली में अंडे डालते है । प्रमुख प्रवाल भित्ति मछलियों में एक है मूरिश आइडल। इसका प्रोथ एक नली के समान है । पृष्ठ पख और गुद पख लंबे और पीछे की तरफ मोडे हुए है ।

प्रवाल भित्ति आवास जो अनेक रंगीन और आलंकारिक मछलियों के सुरक्षा स्थान है, बहुत ही कोमल और सक्रिय पारिस्थितिकी का है जिसका संरक्षण अनिवार्य है । इन आलंकारिक मछलियों के अव्यवस्थित विदोहन पारिस्थितिकी का नाश कर डालेगा और इस प्रवाल स्वर्ग को जरूर एक कब्रिस्थान बना देगा । आलंकारिक मछलियो के व्यापार में लगे उद्यमकर्ताओं को इसके विदोहन, और टैंको में अनुरक्षण केलिए आवश्यक वैज्ञानिक प्रशिक्षण दिया जाना चाहिए ।

समुद्री आलंकारिक मछलियों के अलावा इस जलजीवशाला में *पिराना, मगर, सक्कर कैट, स्पिनी ईल, ओस्कार* और कोई कार्प और अलवणजल मछलियाँ पेर्लस्पोट और टिलापिया भी संरक्षित है ।

यह जलजीवशाला विद्यार्थियों और सन्दर्शकों को अर्न्तजलीय जीवनी के बारे में अध्ययन केलिए सुवर्ण अवसर प्रदान करता है ।

875 कन्याकुमारी में एक ऑलीव राइडली कच्छप का अवतरण और भारत में समुद्री कच्छपों की आकस्मिक पकड – एक टिप्पणी

एस. कृष्ण पिल्लै

सी एम एफ आर आइ का विषिंजम अनुसंधान केन्द्र, विषिंजम – 695 521

प्रस्तावना

भारतीय तटों में देखेजानेवाद्री कच्छपों की पाँच समुद्री जाति हैं *लेपिडोचेलिस ऑलिवेसिया* (ऑलीव राइडली कच्छप), *कीलोनिया मिडास* (हरा कच्छप), *डेर्मोचेलिस कोरियेसिया* (लेथर बैक कच्छप) *एरीटीमोचोलिस इम्ब्रिकाटा* (हॉक्सबिल कच्छप), *और करेट्टा करेट्टा* (लोंगार हेड कच्छप) । भारत में उडीसा और पश्चिम बंगाल में ऑलीव राइडली कच्छप और तमिलनाडु में मान्नार की खाडी और पाक खाडी में हरा कच्छप पकडी जाती थी। पर वर्ष 1980 के प्रारंभ में तमिलनाडु में और 1983 के प्रारंभ में उडीसा में कच्छप की पकड पर रोक लगा दिया और कच्छपों को खतरे में पडी हुई जाति घोषित की गयी । इसके बाद कच्छप मात्स्यिकी भारतीय तटों से प्रचालित विभिन्न संभारों के आकस्मिक पकड बन गयी और जीव वैज्ञानिकों के आकर्षण का केन्द्र बन गया ।

कन्याकुमारी में पकडे गये कच्छप

कन्याकुमारी में 24-8-96 को प्रचालित एक गिलजाल में एक मादा ऑलीव राइडली कच्छप *लेपिडोचेलिस ऑलिवेसिया* पकडी गयी । इसकी कुल लंबाई 79 से मी थी ।

समुद्री कच्छपों की आकस्मिक पकड

आनाय और गिल जालों में समुद्री कच्छपों की आकस्मिक पकड आज की एक प्रमुख समस्या है । भारत के पाश्चिम तट मुम्बई, रत्नगिरी, माल्वन और पश्चिम बंगाल में इस आकस्मिक पकड के बारे में कई रिपोर्ट उपलब्ध है ।

चेन्नै, तोण्डि, मण्डपम, पाम्बन, रामेश्वरम और कन्याकुमारी के निकट कोलच्चल से भी इसकी पकड पर रिपोर्ट मिली है लेकिन केरल और आन्ध्रप्रदेश सें इस पर रिपोर्ट नहीं की गई है । अभी तक की रिपोर्ट के अनुसार 1985-95 की अवधि में 335 समुद्री कच्छपों को आकस्मिक वश पकडा है ।

भारतीय समुद्री कच्छपों की पकड में 65% *ऑलीव राइडली* देखा गया । इसके बाद तमिल नाडु में एलुवारी आमै और *तोणी आमै* नाम से जाननेवाला लेथरबैक कच्छप *डेर्मोचेलिस कोरियेसिया* आता है । यह समुद्री कच्छपों में अत्यधिक विरल और बडे है ।

टूटिकोरिन में मान्नार की खाडी में पाये जानेवाला

समुद्री कच्छप है हरा कच्छप *कीलोनिया मिडास* । इसे तमिल में *पेरामै* कहते है । यह शाकभक्षी है और उच्चमूल्य के भी है । आकस्मिक पकड में 5% तक ये प्राप्त होते हैं । इसके मांस, तेल और कवच विभिन्न देशों में निर्यात किये करते थे । हॉक्सबिल कच्छप *एरिट्मोचेलिस इम्ब्रिकेटा* छोटे आयाम के है और भारतीय तटों में विरल भी है । पुन्नैकायल, मणपाड, टूटिकोरिन, कन्याकुमारी और शक्तिकुलंगरा क्षेत्रों में इसका मांस विषैला मानी जाती है । शरीर के आयाम की तुलना में बडा सिर लोंगार हेड कच्छप *करेट्टा करेट्टा* की विशेषता है । आकस्मिक पकडों में इसका योगदान 7.5% था ।

सांभारवार आकस्मिक पकड

रिपोर्ट की गई 40 आकस्मिक पकडों में समुद्री कच्छपों की 45% पकड आनायों के ज़रिए हुई थी और 20% गिल जालों के ज़रिए । महाराष्ट्र में कच्छपों की अधिकांश पकड (12.5%) डोलजालों के ज़रिए हुई थी। वडिश रज्जु और पोत संपाशों के ज़रिए क्रमशः 12.5% और 2.5% प्राप्त हुई थी । दो बार आकस्मिक वश प्राप्त कच्छपों को समुद्र में वापस छोडा था ।

अभी तक प्राप्त रिपोर्टें के अनुसार यह व्यक्त है कि कच्छपों की 52.5% पकड तमिलनाडु से, 40% महाराष्ट्र से और 7.5% पश्चिम बंगाल से प्राप्त हुई थी ।

लिंग

आकस्मिक पकड पर प्राप्त कुछ रिपोर्टों के अनुसार मादा और नर कच्छप क्रमशः 22.5 और 17.5% थे । 60% रिपोर्टों में लिंग की सूचना नहीं थी ।

876 गुजरात के कच खाडी की प्रशंख मात्स्यिकी पर टिप्पणी

सुजिता तोमस, जो के. किषकूडन, बी. वी. मक्काडिया

सी एम एफ आर आइ का वेरावल अनुसंधान केन्द्र

वेरावल

जामनगर जिले के कच खाडी में अतंराज्वारीय और शैलभित्ति आवास से पवित्र प्रशंख *जाकस पाइरम* बार *अक्यूटा* का वाणिज्यिक विदोहन किया जाता है । संग्रहण का प्रमुख केन्द्र ओखा, सालाया, अराम्डा, पोषित्रा आदि हैं ।

साधारणतया अंतराज्वारीय क्षेत्रों में, निम्नज्वार के समय हस्त चयन से इसका संग्रहण किया जाता है । आजकल स्त्रियाँ भी संग्रहण का काम करती है । वार्षिक प्रशंख उत्पादन 1975 से 1985 की अवधि में 1,114 और 20,899 के बीच में था। 1984-'85 में 20,899 प्रशंखों की उच्च उपलब्धि रिकार्ड की गयी थी । 1985 से लेकर प्रशंख उत्पादन में घटती होने लगी । उस समय की वार्षिक औसत प्रति संख्या केवल 3,362 थी ।

पकडे गये प्रशंखों को व्यास के अनुसार (बडे-10 से मी और अधिक, माध्यम 8-10, से मी, छोटे 6-8 से मी, निम्न आयास के और -क्षति पहुँची हुई) वर्गीकृत किया जाता है और आयाम के अनुसार एक नियत दाम पर मात्स्यिकी कार्यालय, गुजरात सरकार इन्हें खरीदते है। इसके बाद कॅलकत्ता में कार्यरत कुटीर उद्योगों को नीलाम पर देता है ।

यह उच्च मूल्य की संपदा है और निजी उद्यम कर्ता उच्च मूल्य पर इसे खरीदने केलिए भी तैयार है। लेकिन पिछले कुछ सालों का उत्पादन स्वभाव इसकेलिए अवसर नहीं देता है । वर्ष 1987 से देखी गयी घटती शायद अतिविदोहन से हुआ अवक्षय या सरकार द्वारा लगाये गये नाममात्र मूल्य का मछुआरों में हुई विरसता होगी। उत्पादन में हुई घटती का सही कारण जानने केलिए और इस क्षेत्र में प्रशंख मात्स्यिकी की संभाव्यता पर अध्ययन करने केलिए विस्तृत जाँच अनिवार्य है ।

877 वेरावल में अवतरण किये गये सूर्यमीन-*मोला मोला*- एक टिप्पणी

बी. मनोज कुमार, जो. के. किषकूडन, सुजिता तोमस और ए. पी. दिनेशबाबु

सी एम एफ आर आइ का वेरावल अनुसंधान केन्द्र, वेरावल

मोलिडे कटुम्ब की मछलियों को सागरीय सूर्यमीन कहते है । इनका स्थानीय नाम होता है 'ककिडा' । वेरावल के बिडिया मछली अवतरण केन्द्र में आनाय जालों के ज़रिए इनका अवतरण अक्सर होता है । ग्रीष्म के बाद के महीनों में इनका अवतरण अधिक होता है । गरम

महासागरीय क्षेत्रों में साधारणतया पाये जानेवाले और 200-300 मी गहराई में अवास करनेवाले होने पर भी बिडिया में इनको तटीय जलक्षेत्र से पकडा था । इनको अकेला या छोटे झुण्ड में पाये जाते है ।

अभी तक इस कुटुम्ब के तीन वंशों का पहचान किया गया है । ये हैः रानज़ानिया, मस्टुरस, और मोला. भारत के समुद्रों के सूर्यमीनों के बारे में कई रिपोर्ट 1953 से प्रकाशित किये जा चुके है ।

वेरावल में मार्च, 1997 में 25-50 मी की गहराई में प्रचालित आनाय जालों में चार नर सूर्यमीन, मोला मोला पकडे हुए थे । इनकी औसत लंबाई 940 मि मी और औसत भार 45 कि ग्रा था । शरीर बडे गोलाकृति के था; गुद और पृष्ठ पखें भी उसी आकृति के थे । पृष्ठ और पुच्छ पखों के पख पुट अविच्छिन्न थे । इसके समानीत और वृत्ताकार पुच्छ पख रानज़ानिया अंस पख में 11-12 पख अर, पृष्ठ पख में 14-20 और गुद में 14-80 पख अर था और गदा खंट में 12 अर थे ।

878 रामेश्वरम में मान्नार खाडी से पकडी गई भीमाकार मादा ऑक्टोपस

भारत के समुद्रों से यह भीमाकार ऑक्टोपस *(ऑक्टोपस डोफ्लेयिनी)* विरल मात्रा में पकडी जाती है। इसका कारण यह हो सकता है कि ये उत्तर पसफिक, उत्तर कलिफोरनिया और जापान तटों में बसनेवाले हैं। रामेश्वरम में 17 जनवरी, 1997 को इसी प्रकार के एक भीमाकार ऑक्टोपस की पकड के बारे में डॉ ए. पी. लिप्टन और के. जयबालन ने रिपोर्ट की थी ।

मुकुन्दरायर चत्रम के कुछ मछुए अक्तूबर 23, 1997 को बोट सेट गिल जालों का प्रचालन कर रहा था तो 18 मी गहराई से मान्नार खाडी में धनुष्कोटी से इस मादा ऑक्टोपस को पकडा था ।

इसकी कुल लंबाई 150 से मी और पृष्ठ प्रावर लंबाई 52 से मी थी । इसके अभिलक्षणिक छोटे भुज (IV भुज) की लंबाई 60 से मी थी जबकि अन्य पाँच भुजों की लंबाई 98 से मी थी । पहला और दूसरा भुज परभक्षियों द्वारा काट गयी थी। इसका भार 19 कि ग्रा था ।

इसको 5700/-रु. पर नीलाम कर दिया और ए. एस. एफ कंपनी, तिरुवनन्तपुरम, केरल ने इसे खरीद कर विदेश में निर्यात किया ।

सी एम एफ आर आइ के मंडपम क्षेत्रीय केन्द्र, मंडपम के ए. सी. सी. विक्टर और जयबालन द्वारा तैयार की गयी रिपोर्ट

879 पाम्बन में तिमि सुरा *रिकोडोन टाइपस का अवतरण*

पाम्बन में 17-4-98 को 9.2 मी कुल लंबाई के एक तिमि सुरा *रिकोडोन टाइपस* का अवतरण हुआ था। मान्नार खाडी में 30 मी गहराई में प्रचालित परु वलै नाम से जाननेवाला तलीय गिल जाल के ज़रिए पकडे गये इस तिमी का भार 1.5 टन था । जिगर और पखों को निकालकर इसे गाड़ दिया ।

सी एम एफ आर आइ के मंडपम क्षेत्रीय केन्द्र, मंडपम कैम्प के वी. सेतुरामन की रिपोर्ट ।

880 काकिनाडा में बाइकलकर शुकमीन *सीटोस्कारस बाइकलर*

काकिनाडा पोताश्रय में 16-3-'98 को प्राप्त आनाय पकड में स्कारिडे कुटुम्ब की बाइकलर शुकमीन नाम से जाननेवाला *सीटोस्कारस बाइकलर* की एक नमूना प्राप्त हुई । इसकी लंबाई 48.8 से मी थी । काकिनाडा में 35 मी की गहराई में प्रचालित एक आनाय एकक द्वारा यह पकडा गया था । इसका कुछ शारीरिक मापन नीचे दिया जाता है ।

कुल लंबाई	:	488 मि मी
मानक लंबाई	:	387 "
सिर की लंबाई	:	122 "
प्रोथ अंस पख आधार तक	:	106 "
पृष्ठ पख की लंबाई	:	209 "
श्रोणी पख की लंबाई	:	64 "
गुद पख की लंबाई	:	85 "
पृष्ठ पख की लंबाई	:	× + 10
गुद	:	II + 9
अंस	:	I + 13
श्रोणि	:	I + 5

सी एम एफ आर आइ के काकिनाडा अनुसंधान केन्द्र, काकिनाडा के एन बुरय्या की रिपोर्ट

882 टूटिकोरिन में होलोथूरियन *होलोथूरिया स्काब्रा* के जीगर में रन्ध्रपद (गास्ट्रोपोड) परभक्षि की उपस्थिति

एकिनोडेर्मस मन्द गमन करनेवाले होने के कारण दूषणकारी और परभक्षियों के आक्रमण के पात्र बन जाते है । शरीर भित्ति में टोक्सिन्स होने के कारण ये इन आक्रमणों से कुछ हद तक बचे रहते है । स्ट्रोईड्स और एकिनाइड्स के जैसे, शरीर दृढ होते वक्त होने वाले वृंत संदशिका (Pincers) इनके शरीर के उपरितल से अनावश्यक जीवियों को निकालते है । फिर भी एकिनोडेर्मस में परभक्षियों की उपस्थिति विरल मात्रा में होती है ।

हैचरी केलिए ब्रूड स्टॉक संग्रहण करने के अवसरों में कभी-कभी *पिटिका* युक्त *होलोथूरिया स्काब्रा* दिखाये पडते है । एसी नमूनों के शरीर भित्ति काटकर खुलने पर त्वचा की गहराई में एक रन्ध्रपद को देखा । रन्ध्रपद परभक्षी की उपस्थिति कवचाग्र से मालूम पडता है जो कुछ बाहर निकला हुआ दीख पडता है । स्पर्श करने पर यह गाल में वापस हट जाते है । पिछले 35 सालों में हज़ारों *एच. स्काब्रा* का निरीक्षण किया था । पिटिकायुक्त *एच. स्काब्रा* की संख्या बहुत कम थी । साधारणतया *एच. स्काब्रा* की त्वचा की स्थूलता 5-10 मि मी होती है। पिटिका की उपस्थिति त्वचा को और स्थूल बना देती है ।

सी एम एफ आर आइ के टूटिकोरिन अनुसंधान केन्द्र, टूटिकोरिन के डी.बी. जेम्स की रिपोर्ट ।

883 मंडपम से पकडा गया सूर्यमीन *रानज़ानिया लिविस* (पेन्नट)

मंडपम के निकट पाक खाडी में 5.3.98 को एक तट संपाश में 660 मि मी की लंबाई के एक सूर्यमीन *रानज़ानिया लिविस* प्राप्त हुआ । ताज़े स्थिति में ऊपरीतल का रंग गहरा नीला और अधोभाग फीके श्वेत था। प्रोथ से क्लोम छिद्र तक फीके रंग के छह धारियाँ थी जो नीचे की ओर मोडकर अधर प्रोफाइल तक जाती है। तीन पश्च धारियाँ गहरी बिन्दियों से शाखित थी। अधरें आगे की ओर चुके हुये और दाँतों को ओढने वाले थे।

यह नमूना 8.2 कि ग्रा भार की मादा मछली थी। मडंपम क्षेत्रीय केन्द्र संग्रहालय में इसे रखा है । इसके शारीरिक मापन मि मी में निम्न प्रकार है ।

कुल लंबाई	–	660
शरीर का घेर	–	330
सिर की लंबाई	–	240
पृष्ठ पख की लंबाई	–	170
अधर पख की लंबाई	–	105
प्रोथ से अंस पख तक	–	250
प्रोथ से पृष्ठ पख तक	–	560
प्रोथ से श्रोणि पख मूल तक	–	510
प्रोथ से गुद द्वार तक	–	400
अंस पख का आधार	–	40
श्रोणि पख का आधार	–	58
पुच्छ पख भाग में शरीर की लंबाई	–	240
पुच्छ पख की लंबाई	–	65
मूँह द्वार की लंबाई (रेखाछिद्र)	–	45
प्रोथ की लंबाई	–	100
आँख का व्यास	–	35
भार	–	8.2 कि ग्रा
लिंग	–	मादा

सी एम एफ आर आइ के मंडपम क्षेत्रीय केन्द्र, मंडपम के डी. कन्तस्वामि और एन. राममूर्ति की रिपोर्ट ।

GUIDE TO CONTRIBUTORS

The articles intended for publication in the MFIS should be based on actual research findings on long-term or short term projects of the CMFRI and should be in a language comprehensible to the layman. Elaborate perspectives, material and methods, taxonomy, keys to species and general, statistical methods and models, elaborate tables, references and such being only useful to specialists, are to be avoided. Field keys that may be of help to fishermen or industry are aceptable. Self-speaking photographs may be profusely included, but histograms should be carefully selected for easy understanding to the non-technical eye. The writeup should not be in the format of a scientific paper. Unlike in journals, suggestions and advices based on tested research results intended for fishing industry, fishery managers and planners can be given in definitive terms. Whereas only cost benefit ratios and indices worked out based on observed costs and values are acceptable in journal, the observed costs and values, inspite of their transitionality, are more appropriate for MFIS. Any article intended for MFIS should not exceed 15 pages typed in double space on foolscap paper.

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AQUA 2000

"Reponsible Aquaculture In the New Millennium"

Internationl Aquaculture Conference & Exposition

THE JOINT MEETING OF THE EUROPEAN AQUACULTURE SOCIETY & THE WORLD AQUACULTURE SOCIETY IN THE YEAR 2000

INCLUDING

WORLD AQUACULTURE 2000 & AQUACULTURE EUROPE 2000

THE ANNUAL MEETINGS OF THE

EUROPEAN AQUACULTURE SOCIETY & THE

WORLD AQUACULTURE SOCIETY

May 2 - 6, 2000

ACROPOLIS CONVENTION CENTRE

NICE, FRANCE

The city of Nice of the Mediterranean coast of France will host AQUA 2000. AQUA 2000 will be the joint meeting of the World Aquaculture Society & the European Aquaculture Society in the year 2000. AQUA 2000 will include the active participation of other aquaculture organizations and attendees from around the world.

The final plans for AQUA 2000 include a complete conference covering the full range of aquaculture species and topics and an exposition showing the latest in technology and services for the aquaculture industry. A feature of AQUA 2000 will be thematic sessions throughout the conference devoted to the central thrust of the meeting - "Responsible Aquaculture In The New Millennium". These sessions will begin with a plenary assembly at the beginning of the conference and continue with review papers given by distinguished speakers during the other three mornings. In the afternoons the thematic sessions will continue, this time breaking out specific topics derived from the morning review papers. These thematic sessions will provide an opportunity for the aquaculture industry to review the status of all aspects of global aquaculture in the year 2000 and to suggest what needs to be done to ensure further responsible expansion of aquaculture production in the new millennium. In addition to the thematic sessions, 7-8 other concurrent sessions will cover the full spectrum of technical topics and species, as is normal in WAS and EAS annual meetings.

An international aquaculture exposition will be held during the first 3 days of the conference featuring aquaculture products and services from around the world. The exposition will be integrated into the conference session layout and will be a tremendous opportunity for exhibiting companies to reach an international audience of buyers.

A full schedule of post-conference technical visits is being arranged by IFREMER and the variety will provide a most interesting opportunity for attendees. Potential venues for aquaculture tours include Montpelier and Corsica in France and Sardinia and Venice in Italy. Being located on the French Riviera, Nice also offers a base from which to explore many wonderful tourist sights throughout Europe.

For further informartion :

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